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SURVEY OF THE DOMESTIC TUNA INDUSTRY

SPECIAL SCIENTIFIC REPORT: FISHERIES No. 104

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR, DOUGLAS MCKAY, SECRETARY

FISH AND WILDLIFE SERVICE, JOHN L. FARLEY, DIRECTOR

SURVEY OF THE DOMESTIC TUNA INDUSTRY

BY

A. W. ANDERSON, W. H. STOLTING, AND

ASSOCIATES

SPECIAL SCIENTIFIC REPORT: FISHERIES NO. 104

FOREWORD

This report is made in response to the following letter:

UNITED STATES SENATE
COMMITTEE ON APPROPRIATIONS

5 July 1952

Dear Mr. Secretary:

"The Senate recently had before it a bill (H.R.5693) which would have placed a temporary import duty of 3 cents per pound on fresh or frozen tuna and would have directed the Tariff Commission and the Fish and Wildlife Service to initiate investigations of the tuna fishing industry. This bill passed the House but failed of passage in the Senate. The point of issue was entirely the 3 cent duty and there was no objection to the concurrent investigations which the bill would have ordered.

"Subsequently the Senate Finance Committee unanimously passed a resolution directing the Tariff Commission to make the investigation outlined in the bill. The Tariff law provides for such procedure, and the letter of the Chairman of the Committee, Senator George, to the Chairman of the Tariff Commission spelled out the reason for the resolution. That reason, primarily, was to assist Congress in any future legislation concerning tuna fish.

"A number of the Senators have expressed considerable interest in the investigation proposed by the bill involving the Fish and Wildlife Service, and we the undersigned are petitioning you to have such a study initiated and carried out. We are not suggesting any time limit on such a study, but feel that one would be in the best interests of the country and hope that it can be started and concluded reasonably early. The Finance Committee directed the Tariff Commission to report by March 1,1953.

"A copy of H.R.5693 is enclosed. In it you will find the details of the investigation requested.

"Your kind attention in this matter would be deeply appreciated."

Sincerely yours,

(Signed)

William F. Knowland
Richard Nixon
Warren G. Magnuson
Harry P. Cain
Wayne Morse
Guy Cordon

Honorable Oscar L. Chapman
Secretary of the Interior
Washington, D. C.

The investigation mentioned in the above letter as having been proposed in H.R.5693, 82nd Congress, is referred to in Section 3 of that bill, which reads as follows:

> "The Secretary of the Interior shall make a comprehensive study of the long-range position of the domestic tuna industry and recommend such measures as may be appropriate to promote necessary adjustments so that the industry may achieve and maintain a sound position in the domestic economy. In making his study the Secretary of the Interior shall consult with other interested officers and agencies of the Government and may seek information and advice from any other source he deems appropriate. A report of his study and recommendations shall be submitted to the Congress on or before January 1,1953."

A preliminary reply to the request contained in the above letter was dispatched to the co-signers on July 23,1952. It read as follows:

> "I am glad that you and the five other Senators from the Pacific Coast States believe there is a need for a full study of the tuna industry and its current production and marketing problems. I appreciate, also, the recognition in your letter of July 5 that the Department's Fish and Wildlife Service is the proper agency to investigate those phases of the problem which would not come within the scope of the Tariff Commission's study.
>
> "A preliminary examination of the Service's future program with respect to personnel and facilities required for such an investigation indicates that, in the absence of specific funds, it can be made only by deferring some other phases of projects of considerable interest to the fishing industry. In our opinion, however, the seriousness of the situation confronting the tuna industry justifies such a course.
>
> "A further, detailed review of the Service's original economics program, as well as a conference with the Tariff Commission, will be necessary before it will be possible to inform you more fully of the scope of such a study and the date on which it can be completed. Information in this regard will be forwarded to you before the end of July."

Sincerely yours,

/s/ Mastin G.White
Acting Secretary of the Interior.

Immediately prior to the above reply, and subsequently through the summer of 1952, consultations were held with the staff of the Tariff Commission to make sure that the work of that agency in response to a Senate Finance Committee resolution of June 26,1952, would not be duplicated. That resolution directed the Tariff Commission:

> "to make a thorough investigation of the domestic tuna industry, including the effect of imports of fresh or frozen tuna fish on the livelihood of American fishermen, and to report the results of its investigation to the Senate Finance Committee on or before March 1,1953."

A final affirmative reply was sent to the six Senators by the Director of the Fish and Wildlife Service on August 12,1952. A copy of that letter follows:

> "In the Acting Secretary's letter of July 23, he informed you that the scope and date of completion of the proposed study of the long-range position of the tuna industry by this Department could not be determined until representatives of the Fish and Wildlife Service and the Tariff Commission had conferred. Three converences have now been held in order to determine whether the work to be done in this field by the Service would overlap the study requested of the Tariff Commission under the Resolution of the Senate Finance Committee dated June 26.
>
> "From these conferences it appears that, although the request made of the Tariff Commission is very broad, there are phases with respect to the long-range position of the industry which can be undertaken by the Service without duplicating any work contemplated by the Tariff Commission.
>
> "Accordingly, the Service will limit its study to those problems which will supplement the Tariff Commission study and do its utmost to complete its report by March 1,1953, at which time the Tariff Commission is scheduled to file its report with the Finance Committee."
>
> Sincerely yours,
>
> /s/ Albert M.Day
>
> Director

The material contained herein has been assembled by the staff of the Branch of Commercial Fisheries of the Fish and Wildlife Service. Assistance in some phases was rendered by the Defense Fisheries Administration and the Pacific Oceanic Fishery Investigations of the Service. The Department of State rendered useful service by expediting the receipt of various types of information from foreign sources through its foreign stations. Other agencies of the Federal Government, including the Department of Commerce, the Food and Drug Administration, and the Tariff Commission, have been most helpful. This report certainly would not have been as complete and probably would not have been possible without the wholehearted cooperation of those groups in the United States who catch tuna or process, distribute, and import various tuna products. In addition to the fine cooperation between government and industry in this country excellent cooperation also was received from foreign countries through the Department of State.

For additional information on the tuna industry readers are referred to the Tariff Commission's report, entitled Tuna Fish--Report on Investigation Conducted Pursuant to a Resolution by the Committee on Finance of the United States Senate dated June 26,1952. Such things as volume of imports of tuna and tunalike products, tariffs on tuna and tunalike products, etc., not discussed in the Service report, except as necessary to illustrate certain other points, are covered in much more detail in the Tariff Commission report.

The report that follows--and the surveys that preceded it--were completed by the Service without the use of additional funds or special personnel. This was accomplished by detailing a number of Branch of Commercial Fisheries specialists* from their regular duties to carry out those surveys for which they were particularly qualified.

The outline on which the surveys were based and the format of the final report were developed by A.W.Anderson, Chief of the Branch of Commercial Fisheries, and Walter H.Stolting, Chief of the Branch's Economics and Cooperative Marketing Section. They also wrote portions of the final report, including the conclusions, and reviewed and edited the balance.

Others who participated in the preparation of the report are listed below:

BRANCH OF COMMERCIAL FISHERIES

Section and Name	Position	Activity
Economics and Cooperative Marketing:		
DeVora R.Alexander	Commodity Industry Economist Washington,D.C.	Foreign consumption
Donald M.Clifford	Commodity Industry Economist Washington,D.C.	Distribution
Morton J.Garfield	Commodity Industry Economist Washington,D.C.	Consumption

---

* Assistance was also received from two specialists on the staff of the Defense Fisheries Administration and from the Director of the Pacific Oceanic Fishery Investigations.

Section and Name	Position	Activity
Educational and Market Development:		
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William I. Cabaniss	Fishery Marketing Specialist Minnespolis, Minnesota	Consumption
Burt E. Lindgren	Fishery Marketing Specialist Boston, Massachusetts	Consumption
Kathryn Osterhaug	Home Economist Seattle, Washington	Organoleptic tests
Ralph Russell	Commodity Industry Analyst Washington, D. C.	Consumption outlook
Roy C. Stevens	Fishery Products Technologist Seattle, Washington	Consumption
Gustaf T. Sundstrom	Information Specialist Washington, D. C.	Graphics
Norman B. Wigutoff	Commodity Industry Analyst Washington, D. C.	Consumption
Exploratory Fishing:		
Harvey R. Bullis	Fishery Methods & Equipment Specialist, Washington D.C.	Territorial waters and Foreign regulations.
Carl B. Carlson	Chief, Gear Development & Research Program Coral Gables, Florida	Production improvements and alternate uses of vessels.
J.G. Ellson	Chief, North Pacific Fisheries Exploration & Gear Research, Seattle, Washington	Live bait and alternate uses of vessels.
Virgil E. Harris	Electronics Scientist Coral Gables, Florida.	Production improvements.
John J. Murray	Fishery Methods and Equipment Specialist, Portland, Maine.	Potential Atlantic fishing grounds
Donald E. Powell	Ass't Chief, Exploratory Fishing and Gear Development Sec. Washington, D.C.	Territorial waters and foreign regulations.
John E. Rawlings	Fishery Methods and Equipment Specialist Pascagoula, Mississippi.	Production improvements
Stewart Springer	Chief, Gulf Fisheries Exploration and Gear Research Pascagoula, Mississippi.	Production Improvements.
Market News:		
V.J. Samson	Fishery Marketing Specialist San Pedro, California	Liaison with California tuna industry.

Section and Name	Position	Activity
Special Research:		
Clarence R. Lucas	Commodity Industry Analyst Washington, D.C.	World Production
Robert G.Personius	Commodity Industry Analyst Washington, D.C.	World production
Dr.Francis J.Weiss	Formerly Commodity Industry Analyst,Washington, D.C.	World production
Statistics:		
C.E.Peterson	Chief,Statistical Section Washington, D. C.	Canned tuna statistics
C.B.Tendick	Fishery Marketing Specialist San Pedro,California	Operating units statistics
F.M.Wood	Fishery Marketing Specialist Seattle, Washington	Operating units statistics
Technology:		
William Clegg	Chemist, Seattle, Washington	Chemical analyses
Howard Craven	Chemical Engineer Ketchikan, Alaska *	Sample preparation and physical tests
H.E.Crowther	Chief, Technology Section Washington, D.C.	Byproducts and new imported products
Lynne G.McKee	Fishery Technologist Seattle, Washington	Plant surveys and engineering consultant
Bruce F.Sanford	Chemist Seattle, Washington	Plant surveys and experimental packs.
M.E.Stansby	Chief, Pacific Coast and Alaska Technological Research Seattle, Washington	Processing.
Dave H.Wieg	Laboratory Aid Seattle, Washington	Experimental packs

DEFENSE FISHERIES ADMINISTRATION

Dr.Richard A.Kahn	Chief,Branch of Economic Facilities,Washington, D.C.	Foreign and domestic governmental assistance.
Edward A.Power	Chief,Branch of Material Facilities,Washington, D.C.	History of United States tuna industry.

PACIFIC OCEANIC FISHERY INVESTIGATIONS

O.E.Sette	Director, Honolulu, T. H.	Biological outlook.

---

* Detailed by Alaska Fisheries Experimental Commission, Fishery Products Laboratory, Ketchikan, Alaska.

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CHAPTER I -- HISTORY OF THE UNITED STATES TUNA INDUSTRY

ABSTRACT

THE TUNAS ARE ONE OF THE WORLD'S LEADING FISHERY RESOURCES. FIVE SPECIES ARE TAKEN GENERALLY BY UNITED STATES FISHERMEN. THESE ARE ALBACORE, BLUEFIN, LITTLE, SKIPJACK, AND YELLOWFIN TUNA. IN ADDITION, BONITO AND YELLOWTAIL ARE PACKED TUNA-STYLE AND KNOWN AS "TUNALIKE FISHES". HOWEVER, THEY CANNOT BE LABELED "TUNA".

THE UNITED STATES CATCH, WHICH HAS AVERAGED ABOUT 350 MILLION POUNDS ANNUALLY IN RECENT YEARS, IS ONE OF THE MOST VALUABLE FISHERY PRODUCTS TAKEN BY UNITED STATES FISHERMEN. TUNA CANNING BEGAN IN THE UNITED STATES IN 1903 WHEN THE CANNING OF ALBACORE WAS UNDERTAKEN IN SOUTHERN CALIFORNIA. FOR A NUMBER OF YEARS ALBACORE WAS THE ONLY SPECIES CANNED. HOWEVER, AS THE DEMAND INCREASED AND THE SUPPLY OF ALBACORE WAS FOUND TO BE LIMITED, THE PACKING OF OTHER SPECIES WAS UNDERTAKEN. AS THE MARKET FOR CANNED TUNA CONTINUED TO EXPAND, THE NUMBER AND SIZE OF THE FISHING CRAFT INCREASED, AND IT BECAME NECESSARY TO FISH IN WATERS OFF CENTRAL AND SOUTH AMERICA WHERE LARGE CONCENTRATIONS OF SKIPJACK AND YELLOWFIN WERE AVAILABLE THROUGHOUT THE YEAR. BY 1927, THE PRINCIPAL SOURCE OF FISH FOR CALIFORNIA CANNERIES WAS THE WATERS SOUTH OF THE MEXICAN BORDER.

IN 1937, CONSIDERABLE QUANTITIES OF ALBACORE WERE FOUND OFF OREGON AND WASHINGTON, AND TUNA CANNERIES WERE ESTABLISHED IN THOSE STATES. LOCALLY-CAUGHT ALBACORE, AS WELL AS RECEIPTS OF THESE FISH FROM CALIFORNIA AND IMPORTS OF VARIOUS SPECIES OF TUNA FROM LATIN AMERICA AND JAPAN, ARE NOW CANNED IN OREGON AND WASHINGTON.

THE CANNING OF TUNA ON THE EAST COAST OF THE UNITED STATES WAS LIKEWISE BEGUN IN 1937, AND THE FISH ARE NOW PACKED IN SEVERAL ATLANTIC COAST STATES. LOCALLY-CAUGHT BLUEFIN AND LITTLE TUNA, FISH FROM THE PACIFIC COAST AND IMPORTS FROM CANADA, JAPAN AND PERU PROVIDE THE RAW MATERIALS FOR THE EAST COAST CANNERIES. WITHIN A FEW YEARS AFTER TUNA WERE FIRST CANNED IN CALIFORNIA, CANNERIES WERE CONSTRUCTED IN THE HAWAIIAN ISLANDS. THE TWO CANNERIES NOW OPERATED IN THE ISLANDS PACK BOTH LOCALLY-CAUGHT AND IMPORTED TUNA.

AS THE MARKET FOR CANNED TUNA INCREASED, A NUMBER OF COUNTRIES BEGAN EXPORTING FRESH, FROZEN, AND CANNED TUNA TO THE UNITED STATES. IMPORTS OF FRESH AND FROZEN TUNA (PRINCIPALLY FROZEN) WHICH ARE RECEIVED FREE OF DUTY REACHED A PRE-WORLD WAR II HIGH OF 11,046,000 POUNDS IN 1937, AND THEN INCREASED SPECTACULARLY FOLLOWING THE WAR TO 69,003,000 POUNDS IN 1952.

JAPAN BEGAN EXPORTING CANNED TUNA TO THE UNITED STATES IN 1931, BY 1933, IMPORTS OF TUNA CANNED IN OIL, NEARLY ALL FROM JAPAN, WERE EQUAL TO 40.5 PERCENT OF THE DOMESTIC PACK. SINCE THESE JAPANESE IMPORTS WERE FOUND TO BE PRODUCED AT LOWER COST THAN SIMILAR UNITED STATES PRODUCTS, THE DUTY WAS INCREASED FROM 30 PERCENT TO 45 PERCENT AD VALOREM. THIS EFFECTIVELY REDUCED THE IMPORTS. IN 1943, AS A RESULT OF A TRADE AGREEMENT WITH MEXICO, THE DUTY ON TUNA CANNED IN OIL WAS REDUCED TO 22½ PERCENT AD VALOREM. FOLLOWING WORLD WAR II, IMPORTS INCREASED SHARPLY, AND, IN 1950, A TOTAL OF 36,409,547 POUNDS OF TUNA CANNED IN OIL WERE RECEIVED, PRINCIPALLY FROM JAPAN AND PERU.

THE MEXICAN TRADE AGREEMENT WITH THE UNITED STATES WAS ABROGATED AS OF JANUARY 1, 1951, WHICH RESULTED IN THE DUTY RETURNING TO 45 PERCENT AD VALOREM. THE RESULT OF THIS ACTION WAS TO REDUCE IMPORTS OF TUNA CANNED IN OIL TO ONLY 3,618,565 POUNDS IN 1951, AND 4,288,447 POUNDS IN 1952.

SINCE TUNA CANNED IN BRINE, RATHER THAN IN OIL, IS DUTIABLE AT 12½ PERCENT AD VALOREM, JAPANESE TUNA CANNERS BEGAN CANNING TUNA IN BRINE FOR EXPORT TO THE UNITED STATES. IN 1951, IMPORTS OF THIS PACK AMOUNTED TO ABOUT 9,351,758 POUNDS, AND IN 1952, TO 19,032,500 POUNDS.

THE MAJOR PORTION OF THE UNITED STATES CATCH OF TUNA AND TUNALIKE FISHES IS MADE WITH HOOK AND LINE AND PURSE SEINES. RELATIVELY SMALL CATCHES ARE TAKEN BY POUND NETS, HAUL SEINES, AND HARPOONS, AND OCCASIONAL INCIDENTAL CATCHES ARE MADE BY GILL NETS AND OTTER TRAWLS.

THREE TYPES OF FISHING CRAFT ACCOUNT FOR ABOUT NINETY-NINE PERCENT OF THE UNITED STATES CATCH OF TUNA. THESE ARE THE SMALL TROLLERS, OR JIG BOATS, WHICH FISH FOR ALBACORE; THE LARGE TUNA CLIPPERS, WHICH ACCOUNT FOR THE BULK OF THE YELLOWFIN AND SKIPJACK CATCH; AND THE PURSE SEINERS, WHICH ENGAGE PRINCIPALLY IN THE TAKING OF BLUEFIN, BONITO AND YELLOWTAIL.

WHILE MANY MECHANICAL ADVANCES HAVE BEEN MADE IN CANNING TUNA SINCE THE INCEPTION OF THE DOMESTIC INDUSTRY, THE BASIC PROCESSES FOLLOWED HAVE SHOWN LITTLE CHANGE. THE FISH ARE PRE-COOKED AND MOST OF THE PACK IS CANNED IN NO. ½ CANS WITH A SMALL QUANTITY OF SALT AND VEGETABLE OIL. IN RECENT YEARS, THERE HAS BEEN A STRONG TREND TOWARD PACKING CHUNKS AND FLAKES RATHER THAN SOLID MEAT.

IN ADDITION TO THE PRODUCTION OF CANNED TUNA, CONSIDERABLE QUANTITIES OF TUNA BY-PRODUCTS, CONSISTING OF MEAL, AND BODY AND LIVER OILS, AND SOLUBLES ARE MANUFACTURED FROM TUNA WASTE. THE TOTAL VALUE OF TUNA BY-PRODUCTS IN 1952 WAS ABOUT $5,000,000. IN THE SAME YEAR, THE VALUE OF THE CANNED PACK WAS $113,000,833.

A BRIEF SUMMARY OF THE MAKE-UP OF THE DOMESTIC TUNA INDUSTRY FOLLOWS IN TABLE 1.

DESCRIPTION OF SPECIES OF TUNA AND TUNALIKE FISHES

The tunas are one of the world's leading fishery resources. They are widely distributed in temperate, semi-tropical and tropical waters, and although they have been fished for many centuries off Europe, Northern Africa, and Asia, and more recently in the Western Hemisphere and the mid-Pacific, comparatively little is known concerning them. Preliminary research indicates that there may be large populations of tuna in the mid-Pacific and in other areas that are not now fished, and it is possible that they are one of the world's great food reserves.

It is generally considered that five species of tuna, which may be canned and sold as tuna, are landed in the United States. On the Pacific coast the catch includes albacore (*Germo alalunga*), bluefin (*Thunnus thynnus*), skipjack (*Katsuwonus pelamis*) and yellowfin (*Neothunnus macropterus*), while bluefin and little tuna (*Euthynnus alleteratus*) are taken on the Atlantic coast. Blackfin tuna (*Parathunnus atlanticus*) have been caught in the Gulf of Mexico but not in commercial quantities by United States fishermen. The big-eyed tuna (*Parathunnus sibi*) is taken in Hawaii and it is reported that occasionally catches of this species are taken by California fishermen. However, since the fish

TABLE 1. - SUMMARY OF THE TUNA FISHERY

Item	TUNA		
Common name----------------	Albacore	Bluefin	
		Pacific	Atlantic
Scientific name----------	Germo alalunga	Thunnus thynnus	Thunnus thynnus
Distribution in Western Hemisphere-------------	Alaska to Central Lower California	Columbia River to Guadalupe Island, Mexico	Newfoundland south to the Caribbean
United States fishing range--	Alaska to Central Lower California	Southern California to Guadalupe Island, Mexico	New England and Middle Atlantic States
Principal fishing season-----	July to October	May to August	July to Sept.
Sizes:			
Maximum-------------------	About 80 lbs.	About 250 lbs.	About 1600 lbs.
Average-------------------	12-25 lbs.	20-40 lbs.	8-65 lbs. and 65-600 lbs.
Calif. minimum size limits-	9 lbs.	7½ lbs.	-
United States catch:			
1950 (lbs.)----------------	72,414,600	2,761,800	1,267,200
1951 (lbs.)----------------	34,491,000	3,862,000	(1)
Average catch 1941-1950 (lbs.)-	39,295,600	13,003,000	About 1,420,100
Record catch (lbs.)	1950-72,414,600	1935-25,173,100	1948-2,997,300
Smallest catch, 1941-1950 (lbs)-	1941-11,932,200	1950- 2,761,800	1943- 476,300
Pacific Coast catch, 1950----			
Off Pacific Coast States (lbs.)	48,839,100	9,400	-
Off Latin America (lbs.)---	23,575,500	2,752,400	-
Landed in California (lbs.)-	61,746,000	2,739,000	-
Landed in Oregon (lbs.)-----	5,386,100	22,800	-
Landed in Washington (lbs.)--	5,282,500	-	-
Principal fishing gear used--	Troll and live bait gear	Purse seine	Pound nets, hook and line and harpoon
Vessels used------------------	Trollers and small live bait boats	Purse seiners	Various
Contract price, ex-vessel------	$425 per ton	$310 per ton	-
Canned pack:			
1952 [2] (cases)--------------	2,588,326	94,898	(1)
Percent of total 1952 pack---	28%	1%	(1)
Record pack (cases)----------	1950-2,053,842	1946-497,207	(1)
Average pack, 1941-50 (cases)	1,027,960	258,936	(1)
Color classification---------	White meat	Light meat	Light meat
Average value 1952 California pack of 48-1/2 cans per case			
Solid--------------------	$14.74	$14.17	(1)
Chunk--------------------	-	$12.65	(1)
Flake--------------------	$9.09	$9.53	(1)

See footnotes at end of table.

TABLE 1. - SUMMARY OF THE TUNA FISHERY (Continued)

Item	TUNA (Cont'd)		
Common name	Little	Skipjack	Yellowfin
Scientific name	Euthynnus Alletteratus	Katsuwonus pelamis	Neothunnus macropterus
Distribution in Western Hemisphere	Cape Cod south into Caribbean Sea and Gulf of Mexico	Vancouver Is. to coast of South America	Point Conception south to Peru
United States fishing range	New York to North Carolina	Southern Calif. to northern South America	Southern Calif. to northern South America
Principal fishing season	Northern waters in summer and southern in winter	Throughout year	Throughout year
Sizes:			
Maximum	About 20 lbs.	43 lbs.	About 400 lbs.
Average	5-10 lbs.	4-20 lbs.	30-40 lbs.
Calif. minimum size limits	-	4 lbs.	7½ lbs.
United States catch:			
1950 (lbs.)	295,900	126,786,100	187,889,500
1951 (lbs.)	(1)	116,599,000	161,481,000
Average catch, 1941-50 (lbs.)	(1)	51,828,900	117,664,000
Record catch (lbs.)	(1)	1950-126,786,100	1948-199,426,700
Smallest catch, 1941-50 (lbs.)	(1)	1941- 25,585,500	1942- 41,466,600
Pacific Coast catch, 1950:			
Off Pacific Coast States (lbs.)	-	12,400	1,500
Off Latin America (lbs.)	-	126,773,700	187,888,000
Landed in California (lbs.)	-	124,517,000	181,371,900
Landed in Oregon (lbs.)	-	2,269,100	6,517,600
Landed in Washington (lbs.)	-	-	-
Principal fishing gear used	Pound nets and haul seines	Live bait and purse seines	Live bait and purse seines
Vessels used	Various	Tuna clippers & purse seiners	Tuna clippers & purse seiners
Contract price, ex-vessel	-	$280 per ton	$320 per ton
Canned pack:			
1952 2/ (cases)	(1)	1,641,278	4,016,878
Percent of total 1952 pack	(1)	18%	44%
Record pack (cases)	(1)	1950-2,262,351	1950-4,245,346
Average pack, 1941-50 (cases)	(1)	895,349	2,397,357
Color classification	Light meat	Light meat	Light meat
Average value 1952 California pack of 48-1/2 cans per case:			
Solid	(1)	$14.06	$14.25
Chunk	(1)	$12.51	$11.89
Flake	(1)	$9.72	$9.49

See footnotes at end of table.

TABLE 1. - SUMMARY OF THE TUNA FISHERY (Continued)

Item	TUNALIKE FISHES		
Common name-----	Bonito		Yellowtail
	Pacific	Atlantic	
Scientific name-----	Sarda chiliensis	Sarda sarda	Seriola dorsalis
Distribution in Western Hemisphere--------	Vancouver Is. into Lower Calif.	New England to Brazil	Central Calif. to Gulf of California
United States fishing range---	So. Calif. to Cen. Lower California	Massachusetts to Florida	Central California to Gulf of Calif.
Principal fishing season------	Throughout year	North---summer So.-Thruout yr.	Throughout year
Sizes:			
Maximum---------------------	25 lbs.	12 lbs.	About 80 lbs.
Average---------------------	6-8 lbs.	(1)	Under 15 lbs.
Calif. minimum size limits--	-	-	-
United States catch:			
1950 (lbs.)-----------------	695,600	123,500	3,530,000
1951 (lbs.)-----------------	777,000	(1)	4,670,000
Average catch, 1941-50 (lbs.)-	4,927,400	(1)	5,979,200
Record catch (lbs.)-----------	1947-13,697,200	(1)	1948-10,445,700
Smallest catch, 1941-50 (lbs.)	1950-695,600	(1)	1942- 2,726,000
Pacific Coast catch, 1950:			
Off Pacific Coast States(lbs.)	33,400	-	5,600
Off Latin America (lbs.)----	662,200	-	3,524,200
Landed in California (lbs.)-	695,600	-	3,529,800
Landed in Oregon (lbs.)-----	-	-	-
Landed in Washington (lbs.)-	-	-	-
Principal fishing gear used---	Purse seines & live bait	Haul seines, gillnets, hook & line, pound nets	Purse seines and live bait
Vessels used-----------------	Purse seiners & tuna clippers	Various small craft	Purse seiners and tuna clippers
Contract price, ex-vessel-----	$195 per ton	-	$185 per ton
Canned pack:			
1952 2/ (cases)-------------	47,213	(1)	179,787
Percent of total 1952 pack---	.5%	(1)	2%
Record pack (cases)	1947-260,943	(1)	1948- 188,776
Average pack, 1941-50 (cases)-	97,812	(1)	99,387
Color classification----------	Light meat	Light meat	Light meat
Average value 1952 California pack of 48-1/2 cans per case:			
Solid----------------------	$10.33	(1)	$10.50
Chunk----------------------	-	(1)	$8.01
Flake----------------------	$7.97	(1)	$8.08

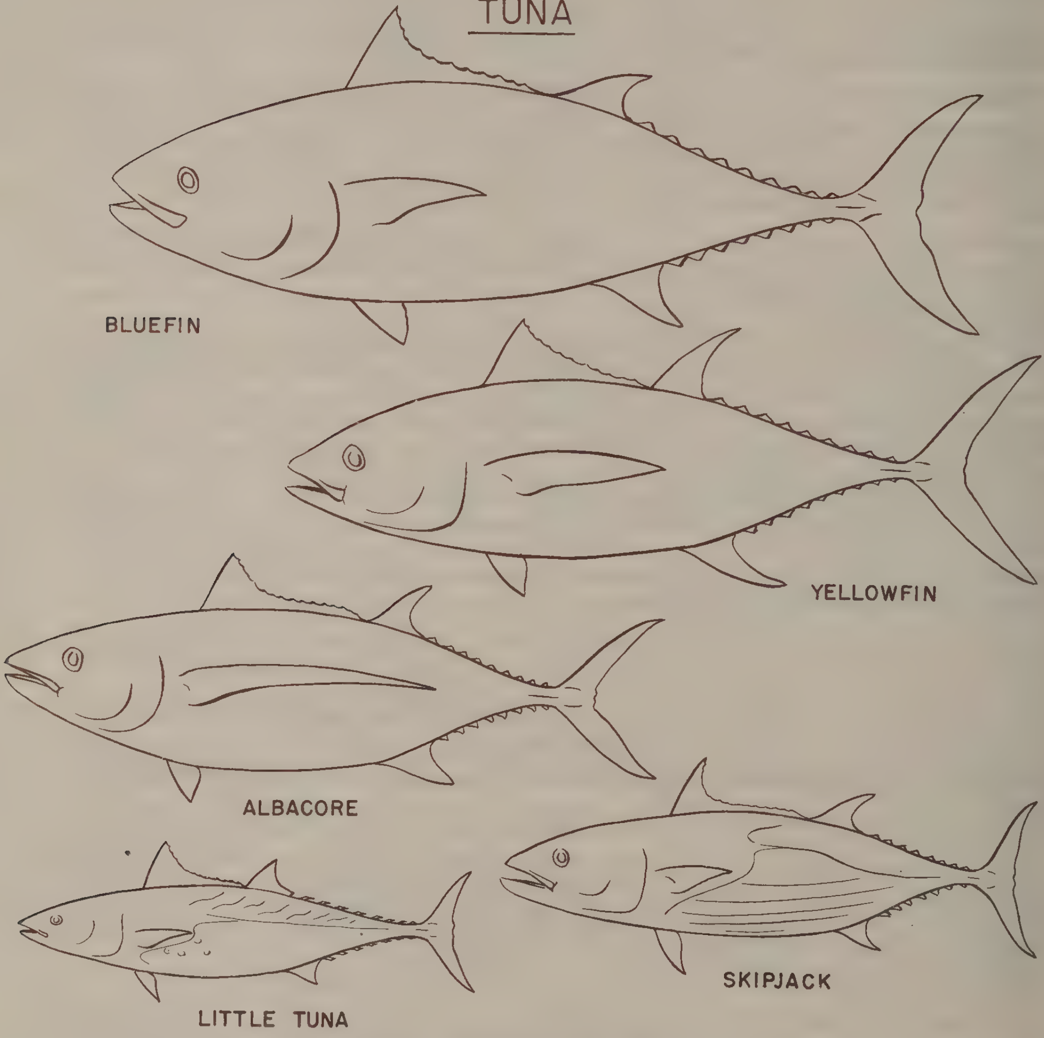
1/ Data not available.

2/ Does not include 546,822 cases of tonno and unclassified tuna.

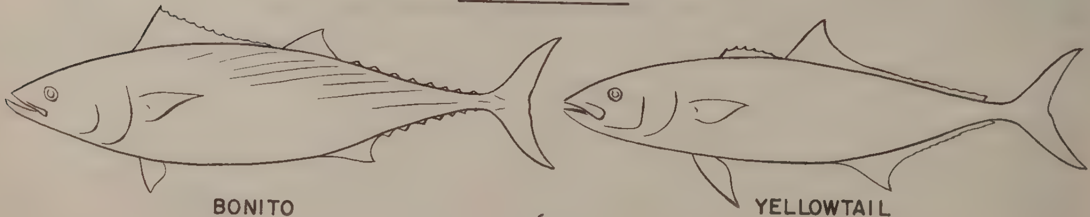
Figure 1.

PRINCIPAL SPECIES OF TUNA AND TUNALIKE FISHES IN UNITED STATES COMMERCIAL CATCH.

TUNA


BLUEFIN
YELLOWFIN
ALBACORE
SKIPJACK
LITTLE TUNA

TUNALIKE


BONITO
YELLOWTAIL

are similar in appearance to yellowfin, the catch is included with that of the latter species. Other species of tuna occur far from areas presently fished by United States fishermen. Reference is made to some of them at appropriate places in this report.

Bonito [Sarda chiliensis (Pacific) - Sarda sarda (Atlantic)], which, like tuna, are members of the mackerel family, and the yellowtail (Seriola dorsalis), a member of the jack family, are canned tuna-style. The pack is considered a tunalike rather than a tuna product. However, Federal regulations require that the cans be labeled "bonito" and "yellowtail", respectively, rather than tuna. In this report data on consumption, production, etc., of bonito and yellowtail, will be discussed with those of the tunas.

Throughout this report when reference is made to tuna and tunalike fishes it will cover the aforementioned seven species of fish. They are shown in outline form in figure 1.

Additional background information about the five species of tuna and the two tunalike species with which the domestic tuna industry is directly concerned follows:

Albacore (Germo alalunga)

Albacore, also called longfin tuna, has lighter meat than the other species, and is the only one which, when canned, the Food and Drug Administration permits to be labeled "white-meat" tuna. Albacore are a dark steel blue on the upper portions of the body, shading into dull silver below, and may be distinguished from other species of tuna by the great length of the pectoral fins, which extend beyond the front of the anal fin. Albacore occur from Alaska to central Lower California, and through the temperate Pacific to Hawaii and Japan. While individual fish may reach a maximum weight of 80 pounds, those taken commercially usually weigh less than 40 pounds and the average ranges from 12 to 25 pounds.

Regulations of the California Department of Fish and Game permit the taking of albacore at anytime. However, none weighing less than 9 pounds may be sold in the State. There are no size or seasonal restrictions on the taking of albacore in Oregon or Washington.

Albacore usually appear on the Pacific coast in the spring or early summer, and disappear in the late fall or winter. Most of the catch is taken from July to October, inclusive. Albacore are the only tuna taken off each of the Pacific Coast States. They have also been taken off British

Columbia and landings have been made in Alaska. In recent years from a third to a half of the United States catch has been taken off Mexico.

Albacore are taken almost exclusively with hooks, either through the use of troll lines or on live-bait gear. In 1952 the domestic catch of albacore sold in the Pacific coast area for $350 per ton during most of the season, advancing to $425 per ton late in the year.

Bluefin (Thunnus thynnus)

Bluefin occur in both the Pacific and Atlantic Oceans. On the Pacific coast they are found from Point Conception, California, south to Peru, and westward to Hawaii, Japan, and Australia. Pacific bluefin attain a weight of over 250 pounds. The minimum legal size limit for the commercial catch in California is 7½ pounds. The average size caught ranges from 20 to 40 pounds. In addition to its importance commercially, bluefin are a famous game fish in both the Atlantic and Pacific Oceans. In the western Atlantic, they occur in the Caribbean and from off the Chesapeake Bay States to Newfoundland. They are also found in the Mediterranean and off the Atlantic coast of Europe, where large catches are made by French, Portuguese, Italian, and recently by Norwegian fishermen. Atlantic bluefin reach a weight of 1,500 pounds. Fish of 400 pounds are common on both sides of the Atlantic.

On the Pacific coast where most of the domestic catch of bluefin is made, they are caught principally between May and August. Only occasional catches are made during the winter months. They are taken off the southern California coast and south to below the tip of Lower California. On the Atlantic coast, bluefin are taken during the summer and fall from June to October.

On the Pacific coast bluefin are taken almost exclusively with purse seines. The Atlantic coast catch is taken with a variety of gear principally lines, harpoons, pound nets, and floating traps. Early in 1953 a price of $310 per ton was established for Pacific coast bluefin. The 1952 Atlantic coast catch sold to canners was valued at about 12¢ per pound.

Skipjack (Katsuwonus pelamis)

While skipjack are the smallest of the commercial tunas, they are probably the most abundant. Known also as "striped tuna", they may be distinguished by four or five dark stripes which extend horizontally along the lower side of the body. Skipjack in the commercial catch usually weigh from 4 to 20 pounds. California regulations prohibit the landing of skipjack weighing less than 4 pounds. Skipjack occur in the eastern Pacific from Vancouver Island to the coast of South America, but are rare north of Point Conception. They are also found in Hawaii and Japan where they are the most important tuna taken. They also occur in the Atlantic Ocean and the Mediterranean Sea.

Since skipjack and yellowfin are taken in largely the same areas by the same boats and type of gear, there is, to a large extent, a single fishery for the two species. However, there is one difference between them. The catch of yellowfin is confined to the coastal shelf and outlying banks and islands, while skipjack may be taken at considerable distances from any shore or bank. Skipjack are taken principally with hook and line using live bait, purse seines and trolling gear. Early in 1953 a price of $280 per ton was established in the Pacific Coast Area for skipjack.

Yellowfin (Neothunnus macropterus)

Yellowfin is the principal tuna taken by California fishermen. They occur in the eastern Pacific from Point Conception south to Chile, and also in Hawaii and the central Pacific to Japan. They also are found in the Atlantic, but apparently less abundantly than in the Pacific. Yellowfin may be distinguished by the rather long pectoral fin reaching, or almost reaching, the front of the anal fin, but not past it, as in albacore. The name is derived from a golden yellow iridescent band found along the side of newly-caught fish. Yellowfin may reach weights of from 300 to 400 pounds, but fish of this size are rare. California limits the sale of yellowfin in the commercial catch to a minimum of 7½ pounds. The average size landed ranges from 30 to 40 pounds.

The northern limit of yellowfin is off southern California, where the fish are normally taken in August and September. To the south the season lengthens and in semi-tropical and tropical waters, they can be taken throughout the year. Yellowfin are taken principally with hook and line using live bait, purse seines and trolling gear. Early in 1953 a price $320 per ton was established in the Pacific Coast Area for these fish.

Bonito [Sarda chiliensis (Pacific) - Sarda sarda (Atlantic)]

The bonitos are related to both the mackerels and the tunas. In California where the major portion of the domestic catch is made, bonito are often taken by tuna fishermen and canned, tuna-style. However, Federal regulations prohibit labeling the pack "tuna". Instead, the labels must bear the designation "bonito". The flesh of bonito is somewhat darker and more strongly flavored than that of albacore, bluefin, skipjack, or yellowfin. Because of this, bonito are considered less desirable and bring a lower price. Bonito are small, ranging from 6 to 8 pounds each. They are coastal fish, occuring in schools at varying distances from the coast in temperate waters. In California bonito are found principally off the coast of southern California and the northern half of Lower California. Bonito are taken throughout the year principally by trolling, live-bait gear and with purse seines. Early in 1953 a price of $195 per ton was established in the Pacific Coast Area for these fish

Yellowtail (Seriola dorsalis)

The Pacific yellowtail is considered a tunalike fish, and, like bonito, the canned pack is included in statistics showing the production of "tuna and tunalike fishes". However, yellowtail are not tuna, but members of the jack family (Carangidae), which includes the jack mackerel, the scad, and many other tropical species. They cannot be labeled "tuna" but must be designated "yellowtail". Their range is from Central California, south along the Mexican coast into the Gulf of California. The commercial catch is made from Point Conception south to the tip of Lower California. While the largest catches are made between June and September, yellowtail can be taken during the entire year, off Mexico.

Yellotail are an important sport fish in southern California and most of the catch north of the Mexican border is made by sportsmen. In recent years, only about one percent of the commercial catch has been taken north of the Mexican border. Yellowtail are taken principally with hook and line generally with live bait and with purse seines. Early in 1953 a price of $185 per ton was established in the Pacific Coast Area for yellowtail.

Little Tuna (Euthynnus alletteratus)

Little tuna are found along the Atlantic and Gulf coasts of the United States and in the Caribbean area. They are closely related to skipjack, and are one of the species properly classed as tuna. Little tuna are pelagic fish of the warm seas, averaging about 10 pounds in weight, but may reach 20 pounds. They are bluish or greenish on the upper portions of the body, shading to a light, silvery color below. In recent years, the major portion of the commercial catch has been taken in New York, New Jersey, Virginia and North Carolina. Until a few years ago, litte tuna were marketed only as fresh fish. There was little demand for them and the catch was of relatively minor importance. In 1946, an east coast packer began canning litte tuna and marketing them as tuna. Although the catch of little tuna has not exceeded 1 million pounds in any year, there are indications that considerable quantities occur in Atlantic coast and Gulf waters and it is probable that the catch will increase considerably as more is learned of their habits and additional tuna-canning operations become established in the East Coast and Gulf States. The major portion of the catch of little tuna is taken with pound nets and haul seines. The fish usually sell at from 3¢ to 4¢ per pound.

THE UNITED STATES TUNA INDUSTRY

The United States catch, which has averaged about 350 million pounds annually in recent years, is taken principally off the three Pacific Coast States, Central and South America. The catch is used almost entirely for canning. In recent years, tuna have vied with salmon as the most valuable fishery product taken by United States fishermen, and as the country's most valuable canned fishery product.

The record 1950 United States catch of tuna and tunalike fishes, amounted to 395,764,000 pounds, valued at $61,729,000 to the fishermen. This catch and imports of 56,711,596 pounds of fresh and frozen tuna in that year were used to produce 174,794,436 pounds of canned tuna and tunalike fishes, valued at $112,830,094 to the packer and by-products valued at about $5,000,000. The value of the canned pack declined to $99,046,206 in 1951, but in 1952 with even heavier imports of fresh and frozen tuna, it rose to a value of $113,000,833 (exclusive of the pack of tuna and noodles). The value of the 1950 pack is still the record, however, since data on the pack for Hawaii are included in the 1952 figure whereas they are not included for 1950.

The taking of important quantities of tuna in the Western Hemisphere is of comparatively recent origin. For many years, small catches of bluefin tuna or horse mackerel had been taken off the New England and Middle Atlantic States for the fresh fish market, but the catch seldom exceeded a few hundred thousand pounds. On the Pacific coast, tuna were well known to southern California anglers prior to the twentieth century. However, the fish were not considered edible and after the angler had his picture taken with his catch, the fish were usually discarded. Tuna was so lightly regarded as food that David Starr Jordan in writing concerning the albacore in American Food and Game Fish, published in 1902, stated that, "As a food-fish, it is of little value, its flesh being coarse and oily.........". At that time, albacore was so plentiful off San Pedro that commercial fishermen often brought in considerable quantities with other species, even though there was no market for them.

The California Tuna Fishery

The failure of the run of pilchards (sardines) in the San Pedro area in 1903 was primarily responsible for development of tuna canning. Albert P. Halfhill, who is recognized as the "father of the industry" had been engaged in packing sardines at San Pedro since the early nineties. In 1903, the sardines failed to appear and a crisis confronted both the fishermen and canners. In an effort to keep his plant operating, Mr. Halfhill began canning other California fishes such as rock cod, jewfish, halibut and albacore. In an attempt to pack an attractive product, a redwood steam box was constructed in which the fish could be steamed. It was found that this process changed the red flesh of the albacore to a creamy white and improved the flavor. Since the steaming process removed the oil from the fish a quantity of vegetable oil was added to each can to bring out the flavor and improve the appearance of the pack.

In 1903, an experimental pack of 700 cases was canned and distributed to eastern and Los Angeles wholesalers. Despite the usual initial difficulties in marketing a new product and the necessity of overcoming consumer resistance to a canned fish having a much different appearance than that of the well established canned salmon, repeat orders began to be received and somewhat larger quantities of the fish were canned in the following three years.

By 1907, the industry began to move out of the experimental stage, and a few years later a trade publication reported that in 1914 a total of eleven canneries had packed a total of 217,000 cases of tuna. While definite proof is lacking, an inspector for the Food and Drug Administration at Los Angeles states in a letter to the Fish and Wildlife Service, dated January 13, 1953, that "it seems quite likely that the first packs were packed salmon style; that is, the raw fish plus salt was placed in the cans which were then sealed and processed with heat." Since this method is not suited to the canning of tuna, the packs would not have sold well.

When the canning of tuna was first begun in southern California, albacore was the only species packed. They were plentiful between Point Conception and the Mexican border and three or four fishermen operating a 40-foot boat could take full loads within fifty miles of San Pedro or San Diego. Within a few years, it was found that the runs of albacore were erratic and packers occasionally required more fish than were available. By 1915, canners were beginning to pack skipjack, yellowfin, and bonito, and in the following year, the canning of bluefin was reported.

As the demand for tuna continued, it became necessary for the fishing vessels to make longer voyages south of the Mexican boundary in search of fish. This required larger boats and raised the problem of keeping the fish fresh. A number of methods were used to prevent loss of fishing time and to insure the quality of the tuna. In 1917, one company outfitted a floating tuna cannery which was towed to the fishing grounds where the fish could be canned a few hours after they were caught. In 1918 it was reported that a second floating cannery operated in Magdalena Bay and other Mexican ports in Lower California. In the following years, a number of firms began operating refrigerated barges at Turtle Bay and other Lower California ports where fishermen could land their catch and take on ice and supplies. The tuna were then shipped to San Diego or San Pedro by tender.

Tuna, like other foods, felt the stimulation of the World War I demand for food, and catch data indicate that a pack of about 1 million standard cases (48 7-ounce cans) was canned in 1920. The industry, in common with many others, passed through a period of readjustment in the post World War I period. Production declined sharply and many packers discontinued tuna canning. However, those who remained soon found it necessary to expand their operations.

Following 1920, the production of the light-meat varieties of tuna, particularly skipjack and yellowfin, increased rapidly. Albacore remained the dominant species through 1925 when the catch totaled 22,207,000 pounds. In the following year, apparently as a result of a change in oceanographic conditions, albacore largely disappeared from the inshore areas where they had previously been taken and the catch declined to only 2,469,000 pounds. The conditions which caused albacore to leave the inshore areas caused skipjack and yellowfin to move further north, and these varieties became the principal species taken.

Since the consumption of canned tuna had been developed largely with the albacore or "white-meat" pack, it now became necessary to educate consumers to use the "light-meat" varieties. As a result of promotional activities by canners and distributors, this change was made, and yellowfin became the dominant species, with skipjack in second place.

The continued increase in the consumption of tuna made it necessary that canners be assured of a sufficient supply of raw material. The fleet was increased in number and size of the individual vessels and more extensive operations were carried on off the coast of Mexico. In 1927, for the first time, the catch south of the Mexican boundary exceeded the production off California. With this year, the principal source of fish for the California canneries moved to the waters off Central and South America.

The day of the large boats and long cruises was at hand. Many changes in methods of operation were made to increase the efficiency of the fishing vessels. Ice was carried in insulated fish holds so that the boats could remain at sea for longer periods, crews' quarters were enlarged to improve living conditions, and diesel engines replaced gasoline engines to provide additional power and increase safety and economy. By 1926, some vessels were 110 feet in length, and were powered with 300 H.P. engines. These larger vessels were designed to operate outside Mexican territorial waters and thus avoid payment of Mexican duties.

Japanese interests had begun operating for tuna in Mexican waters, freezing the fish for shipment to Japan. In 1924, because of a shortage of fish, arrangements were made by some California canners to purchase tuna from the Japanese operating off Mexico. However, these purchases were not large. In 1925, the first commercial imports of frozen tuna were received from Japan. The shipment, totaling about 800,000 pounds, was the forerunner of much larger receipts from Japan and other countries in the future.

As the California fleet of fishing vessels increased in size, they were able to operate in southern waters where large concentrations of skipjack and yellowfin were available throughout the year. The catch continued to increase, and in 1930 exceeded 100 million pounds for the first time. As a result of the world-wide business depression and heavy volume of frozen and canned imports of tuna from Japan, the catch fell sharply to less than 60 million pounds in 1931 and then recovered slowly until 1934, when the duty on tuna canned, in oil, was raised from 30 percent to 45 percent ad valorem. In 1935, the catch reached a new high of nearly 125 million pounds. In the following years, the market for canned tuna continued to expand, and further improvements were made in the size, equipment and range of the large tuna clippers, which had become the backbone of the tuna fleet. By 1937, methods had been developed for freezing the fish immediately after capture in a brine solution. This permitted retention of the fish aboard the vessel in a solidly frozen condition for as long as it was necessary to remain at sea.

To operate more efficiently, the design of vessel tanks was changed so that some could be used for carrying fuel on the trip south and fish on the return. Others were adapted to carrying live bait to the fishing grounds and frozen tuna on the return journey. As the southern tuna grounds were explored, it was found that yellowfin and skipjack occurred from southern California to Peru. Although the particular area in which tuna were abundant varied from year to year, the long range vessels, with a cruising radius of 10,000 miles or more, were able to operate wherever they were to be found.

During the period from 1926 to 1938 canners were assured of a steady supply of the light meat varieties of tuna, but were dependent upon imports of albacore from Japan for most of their white-meat packs. After the large catch of 22,206,923 pounds of albacore in 1925, the catch had declined to less than 2,500 pounds in 1933. However, in 1935, albacore reappeared off southern California and a catch of 2,448,100 pounds was made. Since that year, landings of albacore in California have increased spectacularly, reaching a peak of 61,746,000 pounds in 1950.

The Pacific Northwest Tuna Fishery

In 1937, albacore were found off the coasts of Washington and Oregon in the warmer offshore Japanese Current. It is probable that albacore had always been present in these waters during a portion of each year since they had frequently been sighted in northern waters by sailing ships operating between San Francisco and Alaska. Also, salmon fishermen who ventured into the waters of the Japanese Current had occasionally caught albacore. No attempt had been made to develop an albacore fishery off Washington and Oregon since local fishermen were not familiar with the fish and there was no market for them in the area. There was so little interest in the fish that when salmon trollers occasionally ran through schools of tuna, they were reported to have pulled in their lines and left the area rather than risk damage to their gear by the hard-hitting albacore. Despite the lack of interest in albacore small landings were made in Oregon during most of the years after 1928. In 1933, a Warrenton, Oregon, canner packed a few cases of albacore, the first recorded pack of tuna in the Pacific Northwest.

As a result of the opening of the Oregon and Washington coasts to pilchard fishing in 1934, California fishermen began taking these fish near the edge of the Japanese Current. They sighted albacore in the area and, although the albacore could not be taken by purse seines, their presence was reported and a number of Pacific Northwest fishermen outfitted their boats with albacore gear.

In 1936, a total of 27,600 pounds of albacore was landed in Oregon. While the deliveries were small, they were sufficient to interest both fishermen and packers in the possibility of developing a tuna fishery in the Pacific Northwest. In 1937, the Oregon and Washington catches increased to 1,500,000 pounds and in the following year to 10,001,700 pounds, reaching a peak of 34,361,800 pounds in 1944. In recent years, the catch has averaged about 10,000,000 pounds annually. In the first few years of the Pacific Northwest fishery, a portion of the catch was shipped to California for packing. However, in recent years, the catch has been canned in Washington and Oregon canneries. In fact, tuna have been shipped to the Pacific Northwest from California, Central America and Japan.

The development of the albacore fishery in the Pacific Northwest had a far-reaching effect upon the tuna industry. A number of salmon canneries were quickly adapted to the canning of tuna, and a number of new tuna canneries were constructed. Since albacore are taken largely with small boats, halibut fishermen, salmon trollers, shark fishermen, and other operators of small fishing craft in the Pacific Northwest were able to enter the fishery. The seasons for the other fish previously taken by the fishermen were short and they were desperately in need of another fishery in which they could engage for a portion of the year. As experience was gained in the taking of albacore, some fishermen operated for these fish throughout the season from June to December, fishing from Mexico to the Pacific Northwest. Others fished for tuna only when they were plentiful in the locality in which they normally operated. In years when albacore were plentiful along the coast, as many as 3,000 vessels entered the tuna fishery. Many of these craft have become dependent upon the albacore fishery for a considerable portion of their annual income.

Since the resumption of albacore fishing off the Pacific Coast States, two important trends have occurred with respect to the areas in which the fish are taken. The first has to do with the increase of the volume of the catch off Mexico.

During the period from 1918 to 1941, albacore had been taken south of the Mexican border in only about half of the years, and in no year had the production exceeded 3 percent of the total landings of these fish. No albacore were reported from off Mexico in 1941; however, in 1942 the catch from these waters totaled 2,623,900 pounds, or 11 percent of the total and by 1948 they amounted to 25,926,500 pounds, over half the albacore catch.

In recent years there also has been a trend toward an increase in the catch of albacore off central and northern California. In 1950, landings in the Northern, San Francisco, and Monterey districts of California amounted to 21,235,100 pounds, compared with 9,448,000 pounds in 1949 and the previous high of 4,994,000 pounds landed in 1939.

Prior to the establishment of tuna canneries in the Pacific Northwest, principally at Astoria, Oregon, on the Columbia River, the canning of tuna had been confined almost exclusively to southern California. Since the canners north of San Pedro were dependent on albacore for a supply of raw material, their season was relatively short, and additional sources of fish were desired in order to supply the firms' markets for tuna and to bring about operating economies through longer canning seasons. The first attempts to accomplish this purpose involved the outfitting of freezer ships which could operate off Central America, purchasing yellowfin and skipjack from United States or local fishermen, which could be frozen and taken to northern canneries for processing. This procedure was followed for a number of years, but apparently not too profitably, since these operations have been discontinued.

The second source of tuna has been imports from Japan. Two of the freezer ships that operated off Central America for a time have made a number of trips to Japan and returned with about 1,000 tons of tuna on each voyage. Recently, however, most of the shipments received in the Pacific Northwest from Japan have arrived on regular commercial cargo vessels. Since the northern canneries do not have as easy access to the bluefin, skipjack, and yellowfin available to the southern California canners, they are very much more interested in receiving continued duty free imports of tuna than are most of the packers in the San Diego and San Pedro areas, according to their testimony at U.S. Senate Finance Committee and Tariff Commission hearings.

In recent years, the pack of tuna in Washington and Oregon accounted for about 8 percent of the total domestic production of canned tuna. In 1951, a total of 15 tuna canneries operated in these states.

Tuna Canning on the East Coast of the United States

In 1937, the same year in which the larger catch of albacore in the waters of the Pacific Northwest was resulting in the creation of a tuna-canning industry in Washington and Oregon, the canning of bluefin was begun at Gloucester, Massachusetts. In the summer of 1937, one of the largest fish processing firms operating in that city announced that it was interested in obtaining supplies of bluefin. A local purse seiner began experiments, using a mackerel seine, to determine the most feasible method of seining bluefin; and catches amounting to 132,400 pounds, valued at $5,296 to the fishermen, were landed during the months of July and August.

In 1938, a Pacific coast purse seiner, the *Western Explorer*, from Tacoma, Washington, proceeded through the Panama Canal to Gloucester and began fishing bluefin with a West Coast tuna seine. In that year, nearly a million pounds of purse seine-caught bluefin were landed at Gloucester. Five vessels entered the purse seine fishery for bluefin; however, most of the catch was made by two vessels, the *Santa Maria* and the *Western Explorer*. It was proven that Atlantic coast bluefin could be taken with purse seines; however, the *Western Explorer* was sold to a Canadian interest in 1939, presumably because its catches did not permit profitable operations at the prices offered. The purse seine catch in that year declined to 260,800 pounds and in 1942 the canning of bluefin at Gloucester was discontinued.

No tuna were canned on the east coast during the years from 1943 to 1945, inclusive.

In 1946, a cannery in Maryland and one in Virginia began canning little tuna, the resultant product being labeled "light-meat tuna." The market for canned tuna in the years immediately following World War II was exceptionally strong, and it is believed that additional packers would have canned little tuna had it been definitely decided they could properly be labeled "tuna." It is known that a firm in Mississippi canned experimental packs of the fish and would have begun commercial operations had it been possible to obtain assurance that the pack could have been labeled "tuna." This assurance was given by the Food and Drug Administration in a letter dated August 26, 1948, addressed to the Fish and Wildlife Service which states, "At the present time we are not taking exception to the designation of 'light-meat tuna' when applied to the usual oil pack prepared from *Euthynnus alletteratus*."

In 1948, there was a large increase in the number of east coast tuna canneries with two plants operating in Maine, three in Massachusetts, one in New York, and two in Maryland. In 1950, the canning of tuna was begun in South Carolina. A tuna cannery is under construction at Moss Point, Mississippi. However, no tuna had been canned by the end of 1952. The tuna packed by east coast plants has been obtained principally from six sources. These are the bluefin found off the New England and Middle Atlantic States; the little tuna, which occurs along the Atlantic and Gulf coasts; deliveries of Pacific coast tuna to eastern packers by United States fishing craft; and imports of tuna from Canada, Japan, and Peru.

To date, neither the bluefin nor the little tuna has been taken in sufficient volume along the Atlantic or Gulf coasts to indicate that an important industry can be developed from these species. During 1951 and 1952, the Fish and Wildlife Service conducted exploratory fishing operations with purse seines, gill nets, and long lines, for bluefin off New England, and, while several good individual catches were made, total landings were not impressive. In 1951, the Service, in cooperation with an eastern canner, attempted to locate schools of little tuna off the South Atlantic States, and in 1952, the Service's exploratory vessel Oregon fished for little tuna in the Gulf of Mexico for a short period. Little tuna were taken in both areas, but landings were not large. In the future, considerable quantities of little tuna may be found, but to date, the catch is not believed to have exceeded one million pounds in any one year.

Shipments of fresh tuna from Canada, and of frozen tuna from Japan and Peru, have been received by a number of eastern canners, and in 1952, two Pacific coast tuna clippers passed through the Panama Canal and delivered their catches directly to eastern canners.

Tuna Canning in the Hawaiian Islands

Within a few years after the canning of tuna was begun in California canneries were constructed in the Hawaiian Islands, and by 1917 at least two were in operation. Little information is available on the volume of pack. However, it is known that by 1933 somewhat over 100,000 cases of tuna, consisting principally of skipjack, were packed in Hawaii. Available information indicates that current production in the two canneries now operating in the Territory is about twice that amount. Albacore, big-eyed, skipjack and yellowfin tuna and bonito are taken in the vicinity of the Islands. The major portion of the catch consists of skipjack. Smaller catches of big-eyed and yellowfin are taken and a small quantity of albacore and bonito are landed. The catch for the fiscal year July 1, 1951 to June 30, 1952 was as follows: albacore 86,209 pounds; big-eyed 2,252,985 pounds; skipjack 9,202,765 pounds; yellowfin 817,344 pounds; and bonito 34,046 pounds. The fish are taken with live bait gear and long lines. Whereas nearly the entire catch of tuna landed in the United States is canned, a large portion of the Hawaiian catch is consumed fresh.

In addition to the Hawaiian catch of tuna, canners obtain a portion of their requirements by importing tuna from Japan.

IMPORTS OF TUNA AND TUNALIKE FISHES

Reference has been made to United States imports of various types of tuna products. Tunalike products are also imported into the United States. The development of a market for canned tuna in the United States permitted other nations having tuna fisheries to export a portion of their production to this country. For many years, small shipments of canned tuna had been received in the United States from European packers. These shipments were small and remained so despite the growth of the tuna market in the United States, since they consisted of specialty packs for which there was a limited market, the supply of tuna in Europe was relatively small, and large quantities were not available for export.

The situation in Japan was quite different. That country was the world's major producer of tuna, an exportable surplus could easily be caught, and the Japanese were interested in expanding their trade with the United States. By the mid-1920's, California canners had learned that albacore runs off southern California and Mexico were erratic and the season too short to permit efficient operations. They were, therefore, desirous of obtaining an additional source of raw material. This resulted in Japan becoming a large exporter of frozen tuna, and later of canned tuna, to the United States. As the market for tuna continued to grow, numerous other countries began to ship frozen and canned tuna to the United States. The importation of various types of tuna and tunalike products into the United States is discussed below.

Fresh

Imports of fresh tuna into the United States are of little importance since only small shipments are received from Canada and Mexico. These receipts are used for immediate consumption in the fresh market or for canning. Fresh tuna entered the United States free of duty, under the Tariff Acts of 1913 and 1922, and has been retained on the free list under the Tariff Act of 1930. Imports of fresh tuna probably average less than one million pounds annually.

Frozen

Frozen tuna imported into the United States is used entirely in the production of canned tuna. In recent years, imports of frozen tuna, which are received principally from Japan and Peru, have increased spectacularly and, in 1952, amounted to 69,003,000 pounds. In that year, about 17 percent of the domestic pack of canned tuna and tunalike fishes was produced from imported frozen tuna.

The first shipments of frozen tuna from Japan to the United States were made in 1925, when 831,280 pounds of albacore were forwarded to California canners. Since the Bureau of Chemistry of the U.S. Department of Agriculture ruled at that time that tuna canned from frozen fish must indicate this on the label (Pacific Fishermen Yearbook 1926), it was considered doubtful whether additional shipments would be made. The large albacore catch made in 1925, amounting to 22,207,000 pounds, also made it appear unlikely that canners would be interested in receiving additional supplies of imported frozen tuna, and none were received in 1926. Unfortunately, albacore largely disappeared from their accustomed waters off California and Mexico in 1926 and they did not reappear in volume until 1938. Since a market had been developed for the white meat albacore and many customers wished to continue receiving this pack rather than light-meat varieties, canners were desirous of obtaining supplies of albacore. Shipments from Japan were resumed in 1927, and by 1929 exceeded 6,000,000 pounds. Receipts from Japan remained at about this level until 1937 when they reached a pre-World War II peak of 11,046,000 pounds.

Until 1932, nearly all of the imports of frozen tuna from Japan consisted of albacore. In that year, about one-third of the imports were bluefin, and in the following year, imports included the other species of light-meat tuna. In the following years, imports from Japan have consisted principally of albacore, but have included the light-meat varieties.

Since trade between Japan and the United States was discontinued during World War II, imports of frozen tuna declined sharply, although some light-meat varieties continued to be received from Costa Rica, the Canal Zone, Canada, Peru, and Mexico. In 1948, Japan resumed the exporting of frozen tuna to the United States, and in 1950, shipments amounted to 25,369,000 pounds, over twice the quantity received in any pre-war year. In the same year Peru with shipments of 13,256,000 pounds also became a major exporter of frozen tuna to the United States.

By 1951, imports of fresh and frozen tuna, which consisted almost entirely of frozen tuna, reached 62,085,000 pounds, or 19 percent of the domestic catch of tuna and tunalike fishes and in 1952 they amounted to 69,003,000 pounds.

In recent months two new types of frozen tuna have been imported from Japan. These are frozen, cleaned tuna loins, ready to be cut to the proper size and placed in the cans, and frozen tuna already packed in cans which need only to have oil and salt added before sealing and sterilizing.

In 1951 a bill was introduced in Congress calling for a three cent per pound duty on imports of fresh or frozen tuna. Passage was obtained in the House of Representatives but not in the Senate.

Canned Tuna in Oil, or in Oil and Other Substances

Small quantities of canned tuna in oil were imported into the United States from Europe prior to the development of the domestic canning industry. These imports remained relatively small and have not competed seriously with the domestic pack. After exporting of frozen tuna to the United States from Japan was begun in 1925, fishery firms in that country began to explore the possibility of canning the tuna in Japan and shipping the canned pack to the United States. Experimental packs were canned in 1926 and 1927, and in 1931 a total of 648,900 pounds of canned albacore was shipped to the United States. In the following year, imports of this product from Japan exceeded 5,000,000 pounds, and by 1933, imports of canned tuna from all sources amounted to 14,382,168 pounds, 99 percent of which was received from Japan. These imports wereequal to 40.5 percent of the United States pack of tuna during that year.

As a result of these heavy imports, as well as the imports of frozen fish, the domestic industry found itself in serious difficulty and asked for protection in the form of an increase in the rate of tariff on canned tuna. Under the Tariff Acts of 1922 and 1930, canned tuna was dutiable at 30 percent ad valorem. As the Tariff Commission in its "Section 336" investigation found that foreign production costs were lower, the duty on "tuna prepared or preserved in any manner, when packed in oil or in oil and other substances," was increased to 45 percent ad valorem on January 13, 1934, by Presidential proclamation. Following the imposition of the new duty, imports of canned tuna declined sharply and remained well below those for 1933 until the outbreak of the war in the Pacific, when imports from Japan ceased.

A trade agreement was concluded with Mexico in 1943, which sharply reduced the tariff on canned tuna in oil. Although little canned tuna was produced in that country, one of the points covered in the trade agreement reduced the tariff on tuna canned in oil from 45 percent to 22½ percent ad valorem with the object of stimulating production in that country for the purpose of supplying food for the war effort. However, Mexico never became an important source of supply. Under the Trade Agreements Act of 1934, as amended, the most favored nation policy made this reduction applicable to imports from all countries. After World War II the reduction was also applicable to Japan.

During the period from 1942 to 1949, imports of canned tuna ranged from only 411,918 pounds in 1942 to somewhat over 8,000,000 pounds in 1948. In these years, the canning of tuna was begun in Peru and that country had become the major exporter of this product to the United States. With the end of the war, Japan began rebuilding its tuna fleet and by 1950 was again ready to make large shipments of canned tuna to the United States. In that year, 36,409,547 pounds of tuna canned in oil, 87 percent of which came from Japan, entered the United States. These heavy imports, plus those of tuna canned in brine, amounting to 380,917 pounds, and canned bonito amounting to 8,135,102 pounds, together with a record United States pack of 157,326,462 pounds, resulted in the market being flooded with more canned tuna than it could absorb.

The domestic industry found itself in very much the same situation as in 1933, when it secured an increase in the tariff from 30 percent to 45 percent ad valorem, to halt the heavy imports of canned tuna from Japan. At this point, the Mexican Trade Agreement was abrogated, not as a result of any interest in canned tuna, but because of interests in other commodities covered by the treaty and other considerations. The result of this action was to return the duty on tuna canned in oil from 22½ percent to 45 percent ad valorem effective January 1, 1951. When this was officially announced in June 1950, it resulted in Japanese and other foreign packers shipping all available supplies of tuna canned in oil so that they would reach the United States before the end of the year. This resulted in total imports of tuna canned in oil from all countries reaching 36,409,547 pounds, as compared with 4,504,907 pounds in 1949.

The effect of the increase in the tariff to 45 percent ad valorem is indicated by the decline in imports of tuna canned in oil to only 3,618,565 pounds in 1951, 4,288,447 pounds in 1952.

Tuna Canned in Brine

Although United States packers have on occasion canned tuna in brine, the pack has not been considered equal to that in oil, and only small quantities have been packed. However, as a result of a trade agreement consumated between Iceland and the United States in 1943, tuna packed in brine rather than oil is dutiable at only 12½ percent ad valorem. When it became known that the duty on tuna canned in oil would be increased to 45 percent ad valorem on January 1, 1951, Japanese canners took advantage of the lower duty and shifted from canning tuna in oil to canning tuna in brine. In 1951 shipments of this pack to the United States amounted to about 9,351,758 pounds 1/, compared with not more than 12,844 pounds three years earlier. During 1952, imports of tuna in brine amounted to 19,032,530 pounds.

1/ This and subsequent data on imports of tuna in brine are obtained from a "basket" classification which consists almost entirely of imports of tuna in brine.

In 1952 the Tariff Commission, at the request of members of the tuna industry, conducted an investigation to determine whether imports of certain packs of tuna and bonito were such as to cause or threaten to cause serious injury to the domestic tuna industry. On the basis of its investigation the Tariff Commission found, two Commissioners dissenting, that tuna, canned, not in oil, was not imported in such quantities as to cause or threaten serious injury to the domestic industry.

Bonito and Yellowtail Canned in Oil

Prior to World War II, imports of bonito and yellowtail canned in oil, if any, were negligible. However, large supplies of these fish are available along the coasts of Mexico, Central and South America. During the war, canneries were established in Peru and Chile and both bonito and tuna were packed. A portion of the production was exported to the United States; however, these shipments of canned bonito and tuna in the main were labeled and classified as "tuna" and data on the volume of bonito imported cannot be separated from that of "tuna".

In October 1948, as the result of an investigation made by the Food and Drug Administration, in collaboration with the U.S. Department of State and the Government of Peru, a study was made to determine the species of fish being canned and shipped to the United States as tuna. It was found that bonito (*Sarda chiliensis*) constituted a major portion of the pack. As a result of this study the Food and Drug Administration ruled that thereafter, such imports must bear labels designating the product as "bonito". In 1949, the first year in which statistics are available on imports of bonito, shipments amounted to 8,053,940 pounds. Imports increased to over 10 million pounds in 1951, and to 13,811,535 pounds in 1952. The import duty on bonito canned in oil is 15 percent ad valorem on imports valued at over 9 cents per pound, and 22 percent on those valued at not over 9 cents per pound. Since the declared value of imported bonito is far in excess of 9 cents per pound, they are received under the 15 percent duty. Imports of bonito canned in oil in 1952 amounted to nearly 8 percent of the domestic production of canned tuna and tunalike fishes.

The Tariff Commission in its investigation in 1952 of the effect of imports of bonito canned in oil on the domestic tuna industry found that these imports were not being received in such quantities as to cause or threaten serious injury to the domestic industry.

Bonito and Yellowtail Canned, Not in Oil

Imports under this classification are believed to consist almost entirely of bonito canned in brine. This is a new product to the United States market and is received under the basket tariff classification dutiable at 12½ percent ad valorem resulting from the 1943 Trade Agreement with Iceland. To date, shipments of this product to the United States have been small and in the two years, 1951 and 1952, receipts are estimated to have averaged about 2,000,000 pounds each year.

The Tariff Commission, likewise found that as in the case of tuna canned in brine, and bonito canned in oil, imports of bonito not in oil, were not imported in quantities which caused or threatened to cause injury to the domestic industry.

TUNA FISHING GEAR

The major portion of the United States catch of tuna and tunalike fishes is made with hook and line and purse seines. Relatively small catches are taken by pound nets, haul seines and harpoons, and occasional incidental catches are made by gill nets and otter trawls.

Hook and Line

There are four methods of taking tuna with hook and line. These are trolling, live-bait fishing, keg-line fishing, and long-line fishing.

TROLLING

Trolling involves catching tuna on lures in which barbless hooks have been concealed. These are towed through the water at the end of lines from small boats. A large portion of the albacore catch is made with this gear. A description of this gear and its operation contained in California Bureau of Marine Fisheries, Fish Bulletin, No. 74, follows: "A typical trolling vessel has a 20- to 30-foot pole rigged on each side........ Each is hinged at the heel to the deck or house, or some convenient point, and is lowered from the vertical by a line rove through blocks. When not in use it is carried vertical against the mast or stays. When fishing the poles are lowered to a suitable height from the water. To each pole are attached three or four trolling lines, with a steel or rubber spring in each to absorb the initial shock of a striking fish. The lines are graduated in length and so rigged that each can be pulled inboard without fouling the remaining lines on that side. Typically the lure is attached to the line by a wire leader of varying length. However, the details of the gear construction are as divergent as the fishermen, and all manner of variations can be found.

"In fishing, the vessels cruise in likely areas at a speed of six to eight or more knots. When a fish is caught the respective line is pulled in immediately while the vessel continues under way." Trolling gear is used largely for the taking of albacore. About 70 percent of the albacore catch is made with this gear.

LIVE BAIT

The principal method used by United States fishermen in taking tuna is on live-bait gear. Its success results from the habits of certain species of tuna which feed in compact schools on sardines, anchovies, and other small fish. When feeding tuna locate small fish, they become avaricious and rush to capture the fish or any object that has the appearance of a small fish. To take advantage of this characteristic, the large California tuna clippers fishing yellowfin and skipjack, and some of the smaller craft fishing albacore, are equipped with live-bait tanks in which the bait fish are carried alive to the fishing grounds. On locating a school of tuna, live bait is thrown overboard to attract the tuna to the vessel. When they rush in to take the bait, feathered lures concealing barbless hooks attached to short lines, which are in turn fastened to stout bamboo poles, are cast into the water near the tuna. In their desire to capture the bait, the tuna take the lures permitting the fishermen to heave them over the rail of the boat and onto the deck. Live bait is continually cast over the side to hold the school in the vicinity of the vessel and fishing continues as long as the school remains, or until the fishermen are obliged to discontinue operations in order to care for the fish that have already been taken.

Since yellowfin tuna vary considerably in size, and fish ranging up to 150 pounds each are taken, it is necessary to vary the number of fishermen taking this species according to the size of the fish in the school being fished. This is done by changing the number of lines attached to a single lure. If the tuna average under 30 pounds in weight, one man can take and land the individual fish. However, if the school is found to range from 30 to 50 pounds per fish, two men are required; if above 50 pounds, three men are used; and in some instances fish are taken by four-pole teams. When two, three, or four men are required to boat an individual fish, the lines from the pole handled by each fisherman are attached to a single lure, so that when a fish is hooked, all the fishermen can assist in lifting it from the water and aboard the vessel. The major portion of the skipjack and yellowfin catch, about one third of the albacore catch and a large portion of the bonito and yellowtail catch is taken on live-bait gear.

KEG LINES

Keg line gear, a variation of hook and line fishing, is used in taking bluefin in New England. The gear, consisting of about seventy fathoms of manila line attached to a wire leader and a baited shark hook, is operated from anchored or drifting boats. Chum, consisting of chopped whiting, squid, small butterfish or other fish is used to attract the bluefin. When the bait is taken the fishermen attempts to pull the tuna aboard as quickly as possible. If the fish is too large to be boated immediately, or if more than one fish is hooked at the same time, the keg is thrown overboard and the fish is permitted to fight it until tired out. A single fisherman can operate as many as four keg lines.

LONG LINES

In long-line fishing, a very long line with baited hooks fastened at intervals, is lowered to a predetermined depth in the ocean and allowed to float with the currents for a number of hours. This method is widely used by the Japanese, but is not used by United States fishermen at the present time. It is possible that if it becomes necessary for United States fishermen to move into the tuna-rich waters of the central Pacific, it will be necessary to turn to this method of fishing, since fish in that area appear to be more widely scattered than those near the coast, and to feed at a considerable depth. Albacore, big-eyed, and yellowfin, are the principal species taken with this gear.

Purse Seines

The purse seine method is an impounding device used to enclose schools of fish in a net so that they can be brailed aboard the fishing vessel. The purse seine is a large net about 300 fathoms in length, and 30 fathoms deep, costing as much as $30,000, which is carried on the stern of the purse seiner, a specially-built vessel constructed to operate this type of gear. Upon locating a school of fish a small seine boat with one end of the net attached, is let go and the purse seiner circles the school, paying out the net at the same time. When the two ends of the net are brought together, a purse line running through metal rings attached to the lead line, is drawn in until the bottom of the net is closed and the fish are trapped. Portions of the net are then taken aboard the vessel until the fish are confined to a small area from which they can be lifted aboard the fishing vessel with a large power-operated dip net or brail. Nearly all the Pacific coast catch of bluefin tuna and bonito is taken with purse seines. In addition, considerable quantities of yellowfin and skipjack tuna and yellowtail are taken by this gear.

Pound Nets

On the Atlantic coast, the major portion of the catch of tuna taken in recent years has been caught with pound nets. Pound nets are large structures of netting hung on piles or attached to floating timbers, which obstruct the movement of fish along the shore and lead them through tunnels into net enclosures from which they are unable to escape. The Atlantic coast pound nets with which tuna are captured are constructed principally for the taking of other species. However, the catch of tuna by this gear frequently exceeds a million pounds annually. Bluefin, little tuna, and bonito are taken by this gear.

Haul Seines

The haul seine is a seine which is used to encircle fish moving along the coast. When a school is sighted, the net is payed out from shore around the school, after which the two ends of the net are hauled in until the fish are dragged ashore. This method has been used to some extent in taking little tuna in recent years.

Harpoons

In the New England States, principally in Maine, a fishery for the taking of large bluefin or, as they are commonly called in that area, "horse mackerel", has existed for many years. Fishermen operating from small boats approach the large tuna and harpoon the fish. Each year several hundred thousand pounds of bluefin tuna are normally taken by this method.

TUNA FISHING CRAFT

Three types of fishing craft account for about ninety-nine percent of the United States catch of tuna. These are the small trollers, or jig boats, which fish for albacore; the large tuna clippers which account for the bulk of the yellowfin and skipjack catch; and the purse seiners which engage principally in the taking of bluefin, bonito and yellowtail.

Trollers or Jig Boats

Trollers, or jig boats, are relatively small craft which may fish for salmon, halibut, and other species during portions of the year, and albacore when these fish are available. These vessels seldom exceed 60 feet in length and are usually valued at from $8,000 to $40,000. The vessels carry ice in which the catch is preserved. The fleet is capable of tremendous expansion when fish are running in large numbers, since there are several thousand small vessels on the Pacific coast that can be equipped with trolling lines, a relatively inexpensive type of gear. The number of vessels entering the albacore fishery each year varies considerably, depending on the size of the albacore run and its dispersion along the coast. The availability of other fish, particularly salmon, also influences the size of the troll fleet. If fishing for salmon or other species, is profitable, many vessels will remain in these fisheries instead of outfitting for albacore.

Purse Seiners

Purse seine vessels are a special type of fishing craft having a wide stern equipped with a turn-table, capable of handling a purse seine weighing many tons. In the early days of the tuna fishery, there were no seiners that fished solely for tuna. Instead, pilchard, salmon, and herring seiners outfitted for tuna seining during the off-season for other species. In recent years, however, a number of large seiners operate for tuna on a year-round basis. These are long-range craft which fish almost exclusively for yellowfin and skipjack tuna in the same areas and at the same time that the tuna clippers or live-bait boats are taking these species. The present fleet of year-round seiners numbers about 15 vessels ranging in size from about 90 to 120 feet in length. In addition to these craft, there is a fleet of about 100 part-time tuna seiners. These craft are smaller than the year-round vessels and, therefore, confine their tuna fishing to the waters off the coasts of Mexico and Costa Rica. These craft account for the major portion of the United States catch of bluefin, bonito, and yellowtail. There is an additional fleet of local purse seiners, about 50 in number, which fishes for tuna in southern California waters. These craft fish for pilchards and mackerel during the seasons for these fish and take tuna at other times of the year. Some of the seiners are equipped with refrigeration equipment which permits the catch to be frozen and stored dry at below freezing temperatures. The remainder of the fleet carries crushed ice in which the catch is preserved.

Tuna Clippers

Tuna clippers, or bait boats, are the backbone of the tuna fleet. These are large craft ranging from 65 to 150 feet in length and having a carrying capacity of from 40 to 600 tons. The average carrying capacity of the present fleet of about 190 vessels is 230 tons. These craft are distinctive and picturesque; with a raking stem and raised deck forward, extending two-thirds the length of the hull to the large bait tanks aft. The majority have the hold divided into water-tight compartments in which bait can be carried on the outward voyage and frozen tuna on the return trip. The clippers are equipped to freeze their catches in brine and store them dry at below freezing temperature

Over 10 percent of the fleet carry airplanes for spotting bait and schools of tuna. The vessels are equipped with radar, loran, radio direction finders, automatic pilots, depth-sounding devices, radio telephones, and evaporators for converting salt water to fresh water. The vessels, manned by 10 to 14 men, have a cruising range of as much as 10,000 miles or more. Because of their size, bait-carrying facilities, refrigeration equipment and the navigation aids carried, tuna clippers are the most expensive commercial fishing craft operated in the world. Individual vessels have cost nearly $700,000. The catch of tuna clippers consists largely of skipjack and yellowfin. In addition, a considerable portion of the bonito and yellowtail catch is made by these vessels. Of all fishing craft these are particularly important with respect to National Security for use in wartime patrol and transport work for the armed forces.

TUNA CANNING PROCESSES AND TYPES OF PACKS

While many mechanical advances have been made in canning tuna, the basic procedures followed have been essentially the same since the inception of the domestic industry in California in 1903. On receipt of tuna at the cannery, the fresh or thawed frozen fish are eviscerated, washed, and placed in wire mesh baskets in which they are cooked in steam retorts. After cooking and subsequent cooling, the tuna are cleaned and the four large longitudinal muscles, called loins, are prepared for canning. These are cut to can size and packed in the cans by hand or mechanical means. Oil and salt are added after which the cans are sealed and processed. In the early days of the industry only olive oil was used in the canning process. However, by 1913, cotton seed oil had replaced olive oil in most packs except for the tuna canned "tonno style" in which olive oil is still used. More recently, soybean oil has become the principal oil used in the regular pack.

Because of the low margin of profit at which tuna operators operated in the early years of the industry, efforts were made to obtain the maximum yield from the tuna processed. As early as 1914, several companies packed a combination of light and dark meat tuna; however, the product did not become popular. In recent years, the packing of a mixture of light and dark meat has been resumed, and the product is available to consumers at a considerably lower price than the light-meat flake and grated packs. Other types of canned tuna marketed in the early days of the industry included kippered tuna and a product known as "potted tuna", which consisted of chunks of tuna mixed with potatoes and carrots. A considerable quantity of this product was packed, but it was eventually discontinued.

In addition to the canning of a number of types of tuna products in the early days of the industry, various types of cans and can sizes were experimented with to determine the size and shape of container most suited to the packing of these fish. Sizes used included a No. $\frac{1}{4}$ can; No. $\frac{1}{2}$ and No. 1 round, tall, and oval cans; and No. 4 tall cans.[2] The No. $\frac{1}{2}$ round can soon became and remains the principal tuna can. In 1920, a change was made in the size of the No. $\frac{1}{2}$ tuna can in which the major portion of the pack had been canned to that date. The height of the can was changed from 2 inches to 1 13/16 inches to permit the production of a tighter pack. The diameter and net contents remained the same.

In the early days of the industry, only solid pack tuna was canned. However, within a few years, the packing of broken pieces was started. Canning of flake tuna, as the product was known, remained a minor portion of the production, and as late as 1938 it accounted for only 7 percent of the annual pack. Until that year, only small broken pieces of tuna had been canned in the flake pack. However, in 1939 the grating of whole loins of tuna was begun, in order to pack what became known as grated tuna. In some instances, the meat was grated into relatively small pieces. However, in other instances, the small pieces were interspersed with larger chunks. This pack was especially suited to the preparation of tuna salads. In the first year that this style was canned, the portion of chunk, flake and grated pack increased to 12 percent of the total production. By 1945, nearly 42 percent of the tuna canned consisted of chunk, flake and grated pack, and in 1952, 45 percent of the total pack consisted of chunk pack and 20 percent flake and grated.

While attempts have been made to pack a large variety of tuna products besides the regular solid, chunk, flake and grated packs in oil, these items account for a very high percentage of the total production. Specialty tuna products which are regularly canned, include a "tonno" pack which consists of solid-meat tuna, packed in a special type of can with olive oil and about double the quantity of salt used for the regular pack. Bluefin and skipjack are the preferred species for the tonno pack, since a more pronounced flavor is desired. For a number of years a dietetic pack, without added salt, has been canned as well as baby food. Small packs of tuna paste have been prepared, and recently a pack of tuna and noodles has appeared on the market. Other packs which have been produced in limited quantities include deviled tuna and a combination tuna and string bean pack "tonno style". Efforts have been made to market a tuna frankfurter, but canning of this product has been discontinued.

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[2] Commonly referred to as the "4 pound can" but designated as No. 4 tall can or No. 4 can in this report for convenience.

A recent, possibly far-reaching development in the canning of tuna has been the importation from Japan of cooked, cleaned and frozen albacore loins. There is a saving of over 50 percent in weight in shipping loins, compared with the whole fish, and there is a further saving in labor cost in having loins prepared in Japan rather than in United States canneries. An even newer development has been the importation from Japan of sample shipments of frozen tuna packed in cans which need only to have oil and salt added before sealing and sterilizing.

A recent innovation in the packing of tuna has been the wide acceptance by the industry of automatic filling machines for the canning of chunks, flakes and grated, and solid-pack tuna. At the present time, most of the domestic pack of tuna is being packed with these machines, which displace much of the labor formerly required in hand-packing the fish.

TUNA BY PRODUCTS

The domestic catch of tuna, as well as imports of fresh and frozen tuna, are received by canners as whole fish except for recent small imported shipments of frozen cooked loined and sample shipments of frozen cooked tuna in cans. Since less than half of the landed weight of the fish is packed in the can, a large volume of waste material, consisting of heads, tails, fins, skins, dark meat, bones, and viscera, is available for the manufacture of by-products. This waste material has been used since the early days of the industry, in the manufacture of fish meal and oil.

In the early 1930's, when a demand developed for high potency vitamin A and D oils, it was found that tuna livers were suitable for the manufacture of these oils. The separation of the tuna livers from the other waste products was begun at that time. Considerable quantities of tuna livers also have been imported and used in the manufacture of tuna liver oils.

In recent years, a considerable quantity of condensed fish solubles have been manufactured from the press liquor obtained when the liquids are extracted from the tuna waste. A liquid fertilizer is also manufactured from tuna waste materials.

Accurate information is not available on the production of tuna meal and oil, since the yield of these products is included with the production of meal and oil produced from Pacific and jack mackerel. On the basis of the quantity of waste material available for reduction, it is estimated that there were produced in 1952 about 22,000 tons of tuna meal, valued at $2,900,000 to the manufacturer and 775,000 gallons of tuna oil, valued at $425,000.

Data have been collected on the yield of tuna-liver oil since 1940; however, for the first few years the figures do not accurately indicate the actual production, since large quantities of wash oil were used in the manufacturing process, which disguised the quantity and value of tuna-liver oil extracted. It is probable that the peak production of tuna-liver oil occurred in 1945, when the yield was reported as 51,399 gallons, valued at $1,576,922. As a result of the decline in th price of natural vitamin oils, production of this oil has declined since that year, and, in 1951, totaled only 12,979 gallons, valued at $272,942. It is probable that the production of tuna-liver oil in 1952 was even less than in the previous year. It is estimated that the production of solubles manufactured from tuna waste in 1952 amounted to about 36 million pounds, valued at $1,600,000. The total value of tuna by-products produced in 1952 was about $5,000,000. This compares with the figure of $113,000,833 already mentioned as the value of the 1952 pack of canned tuna and tunalike fishes. With this comparison it is easily discernible that presently the mainstay of the domestic tuna industry is the sale and consumption of the canned products of the industry.

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CHAPTER II — CONSUMPTION

ABSTRACT

BECAUSE TUNA AND TUNALIKE FISHES ARE PRODUCED FROM A RENEWABLE NATURAL RESOURCE THAT THUS FAR HAS PRODUCED BOUNTIFULLY, SUPPLY EXERTS A LESSER INFLUENCE ON THE ECONOMICS OF THE TUNA INDUSTRY THAN DOES DEMAND AS REFLECTED BY CONSUMPTION. CONSUMER DEMAND IS OF PRONOUNCED IMPORTANCE, SO THAT AN APPRAISAL OF FISH CONSUMPTION IN GENERAL AND OF TUNA AND TUNALIKE FISHES, IN PARTICULAR, IS WORTHY OF CONSIDERATION.

PER CAPITA CONSUMPTION OF ALL FISHERY PRODUCTS HAS NOT CHANGED SIGNIFICANTLY SINCE 1909. ABUNDANT SUPPLIES OF MEAT, POULTRY, EGGS, CHEESE, AND OTHER PROTEIN FOODS IN THE UNITED STATES HAVE BEEN A LIMITING FACTOR IN THE DEMAND FOR FISHERY PRODUCTS. TECHNOLOGICAL IMPROVEMENTS HAVE RESULTED IN A GREATER PERCENTAGE OF THE CATCH BEING CANNED, AND IN MORE RECENT YEARS, QUICK-FROZEN. CANNED FISH REMAINS THE MOST IMPORTANT PROCESSED FISHERY PRODUCT BOTH IN VALUE AND IN QUANTITY. THE TWO LEADING CANNED FISH PRODUCTS, TUNA AND SALMON, SHOW DIVERGENT CONSUMPTION TRENDS. TUNA CONSUMPTION HAS BEEN INCREASING, WHILE SALMON CONSUMPTION HAS DECLINED. A GROWING PROPORTION OF THE CANNED TUNA MADE AVAILABLE TO AMERICAN CONSUMERS COMES FROM FROZEN AND CANNED IMPORTS.

OF THE CANNED PRODUCTS PRODUCED BY THE TUNA INDUSTRY THERE HAS BEEN A DECLINE IN THE VOLUME OF SOLID PACK AND AN INCREASE IN THE CHUNK AND FLAKES STYLES. THIS TREND IS EXPECTED TO CONTINUE.

AMERICAN CONSUMERS, ON THE WHOLE, ARE ACCUSTOMED TO TUNA CANNED IN OIL, AND TUNA CANNED IN BRINE HAS NOT YET MADE SIGNIFICANT INROADS IN SALES TO HOUSEHOLD CONSUMERS. ON THE OTHER HAND, THE INSTITUTIONAL MARKET HAS ALMOST ENTIRELY REPLACED THE OIL PACK WITH THE IMPORTED BRINE PACK.

FROM THE CONSUMER POINT OF VIEW, THERE ARE ONLY TWO VARIETIES OF CANNED TUNA -- WHITE MEAT (ALBACORE) AND LIGHT MEAT (SKIPJACK, YELLOWFIN, BLUEFIN AND LITTLE TUNA). THE WHITE MEAT OF THE ALBACORE COMMANDS A PREMIUM ON MOST DOMESTIC MARKETS. THE MORE ABUNDANT LIGHT-MEAT SPECIES MAKE UP MOST OF THE TUNA PACK. INCREASES OR DECREASES IN THE USE OF THE RESPECTIVE SPECIES FOR WHITE-OR LIGHT-MEAT PACKS IS EXPECTED TO BE DETERMINED PREDOMINANTLY BY THE AVAILABILITY OF EACH SPECIES IN THE RAW STOCKS. THE MARKET FOR CANNED TUNALIKE SPECIES WILL BE SUPPLIED LARGELY BY FOREIGN PRODUCERS.

THE NO. $\frac{1}{2}$ CAN PREDOMINATES IN THE TUNA CANNING INDUSTRY. MOST PROCESSORS DO NOT ANTICIPATE ANY MARKED CHANGE IN PRESENT USE OF CAN SIZES.

EAST COAST PACKS, ALTHOUGH RELATIVELY SMALL, ARE AS ACCEPTABLE AS WEST COAST PACKS WHEN RAW STOCKS FROM THE SAME SOURCES ARE USED. IT IS NOT EXPECTED THAT THE GEOGRAPHICAL POINT OF PACKING WILL INFLUENCE THE CONSUMER INSOFAR AS THE QUALITY OF COMPARABLE SPECIES IS CONCERNED.

AMONG INSTITUTIONAL USERS, CANNED BONITO IN OIL OR BRINE, MOSTLY IMPORTED, HAS MET WITH OVERWHELMING ACCEPTABILITY.

IN GENERAL, CONSUMERS APPEAR TO RECOGNIZE THE DIFFERENT STYLES OF PACKS OF CANNED TUNA ALTHOUGH THEY MAY NOT BE GENERALLY AWARE OF STANDARDS WITH RESPECT TO ORIGINAL QUALITY OF FISH OR FILL OF CONTAINER.

THERE APPEARS TO BE NO MARKET OF CONSEQUENCE FOR TUNA PRODUCTS OTHER THAN THE STANDARD CANNED PACK UNLESS MIXED PRODUCTS, SUCH AS TUNA AND NOODLES, ARE ACCEPTED. FEW ATTEMPTS HAVE BEEN MADE TO MARKET OTHER TYPES OF TUNA PRODUCTS, BUT THE SUCCESSFUL EXPERIENCE OF THE MEAT INDUSTRY, WITH ITS NEW PRODUCTS, OFFERS HOPE.

MOST HOUSEWIVES ARE IN THE HABIT OF PURCHASING CANNED TUNA BY BRAND NAME. INSTITUTIONAL CONSUMERS ON THE OTHER HAND ARE PRIMARILY PRICE-CONSCIOUS.

THE MARKET FOR CANNED TUNA IN THE UNITED STATES IS CAPABLE OF EXPANSION. PROMOTION AMONG INSTITUTIONAL USERS HAS BEEN SHOWN TO BE FRUITFUL. PROMOTION OF CANNED TUNA SHOULD BE SUCCESSFUL IN THE SEVERAL GEOGRAPHICAL, OCCUPATIONAL, AND INCOME GROUPS IN THE UNITED STATES WITH LOW PER CAPITA CONSUMPTION. INDUSTRY-WIDE PRODUCT PROMOTTION, IN ADDITION TO BRAND ADVERTISING AND GREATER RECIPE INFORMATION AND DEVELOPMENT, WERE RECOMMENDED MEANS FOR DEVELOPING MARKETS.

TRADE OPINION AND STATISTICAL ANALYSIS ESTABLISH THAT THE PRICE RELATIONSHIP BETWEEN CANNED SALMON AND CANNED TUNA IS THE MOST SIGNIFICANT OF THE MANY FACTORS FAVORABLY AFFECTING THE DEMAND FOR CANNED TUNA. DATA SHOW HOW THE CONSUMPTION OF CANNED TUNA INCREASED AS THE RATIO OF CANNED TUNA PRICES TO CANNED SALMON PRICES DECREASED, THUS MAKING TUNA A RELATIVELY MORE ATTRACTIVE BUY TO THE CONSUMER.

THE RESULTS OF TWO GOVERNMENT SURVEYS INDICATE THE SUBSTANTIAL INCREASE IN THE NUMBER OF HOUSEHOLDS CONSUMING TUNA AS INCOME MOVES UPWARD.

THE RISING DEMAND FOR TUNA HAS BEEN GIVEN ADDED MOMENTUM BY THE LARGE EXPENDITURES OF THE TUNA INDUSTRY FOR ADVERTISING AND PROMOTION WORK.

A STATISTICAL TECHNIQUE WHICH ASSUMES THAT THE FACTORS AFFECTING CANNED TUNA CONSUMPTION IN THE PAST WILL CONTINUE, INDICATES THAT THE UNITED STATES MARKET WILL CONSUME (BASED ON APPARENT SUPPLY DATA) ABOUT 292 MILLION POUNDS, OR A PACK OF 15 MILLION STANDARD CASES IN 1960 AS COMPARED TO 1952 CONSUMPTION OF ABOUT 11 MILLION STANDARD CASES.

IT SEEMS PROBABLE THAT THE CONSUMPTION OF CANNED TUNA IN THE UNITED STATES IN 1953 WILL EXCEED THAT OF 1952 BY AN APPRECIABLE AMOUNT, POSSIBLY 5 PERCENT, AND LESS PROBABLY, BY AS MUCH AS 10 PERCENT. THEREAFTER, THE CONSUMPTION CAN BE EXPECTED TO INCREASE BY MODERATE INCREMENTS, AND PROBABLY NOT EVERY YEAR, AT A GREATER RATE THAN THAT OF THE INCREASE IN POPULATION. WITHIN TEN YEARS IT IS PROBABLE THAT CONSUMPTION WILL HAVE INCREASED BY 50 PERCENT BUT IT DOES NOT SEEM LIKELY THAT IT WILL INCREASE AS MUCH AS 150 PERCENT IN THAT TIME. OVER THE LONG PULL, ANY FIGURE BEYOND 5 POUNDS PER CAPITA ANNUAL CONSUMPTION OF CANNED TUNA WOULD SEEM ENTIRELY UNREALISTIC. EVEN 3 POUNDS IS RATHER OPTIMISTIC. THE DEVELOPMENT OF SPECIALTY PACKS, SUCH AS SMOKED OR SPICED TUNA, DOES NOT SEEM LIKELY TO REACH SIGNIFICANT VOLUME IN RELATION TO STANDARD TYPES OF CANNED TUNA.

IT IS PROBABLE THAT THERE WILL BE SOME INCREASE IN THE USE OF FRESH AND FROZEN TUNA IN THE NORTHEAST AND IN THE PACIFIC COAST STATES FOR HOME CANNING, AS WELL AS FOR IMMEDIATE CONSUMPTION. THE POTENTIAL AMOUNT IS PROBABLY NOT LARGE ENOUGH TO JUSTIFY PROMOTION.

MARKETS FOR FISH MEAL PRODUCED BY THE TUNA INDUSTRY PRESENT FAVORABLE PROSPECTS WHILE MARKETS FOR FISH OILS AND FOR VITAMIN-BEARING OILS FROM FISH LIVERS AND VISCERA OF TUNA ARE UNFAVORABLE.

GENERAL

An analysis of the consumption of tuna and tunalike fishes is most appropriate as a starting place for the research phase of this study. Consumption is the keystone in the arch of the economic elements which govern the tuna industry. Tuna [3] are products of a renewable natural resource, a resource which has not been exploited to the full and one which has produced bountifully. The demands of consumers for the products of such a resource exert a profound influence on the economic well-being of the industry commercially producing those products. In situations of this kind, supply and suppliers are not the potent force which they would be if supplies were limited. Consumer demand is the more potent force in industries of this type and in the tuna industry.

There are many examples of conditions such as this throughout the fisheries of the Nation. It is quite possible, for example, to harvest annually many millions of pounds more of whiting from the Atlantic Ocean, yet fishermen are held in check from doing this by consumers. A brake is exercised on the production urges of fishermen, because consumers will use currently only from 80 to 90 million pounds (round weight) of whiting annually at prices sufficient for the producer to harvest this product. Any increase in production above this level drives the price of whiting down to a point where production brakes are set into motion as a result of consumer dictates. There are also many unused fishery resources such as the menhaden which are not exploited to any degree for food purposes simply because consumers do not fancy the product. On the other hand, sometimes changes in consumer desires open a flood-gate of demand for a particular fishery product to the ultimate benefit of fish producers. There was a time when "pink" or "brown" shrimp could not be sold to consumers in the United States because the colors supposedly were an indication of spoilage. Experience , promotion, and price reversed consumer attitudes. Today they purchase many millions of pounds of "pink" and "brown" shrimp. With respect to natural resources such as these, including the tuna industry, the consumer is "king".

The pronounced effect of consumer demand on the economics of the tuna industry has been apparent, particularly in recent years. With the decline in production of canned salmon and the rise in consumer's incomes, the demand for tuna intensified and has been a stimulant to increase tuna production. Considerable statistical analysis of the demand for tuna was undertaken in conjunction with this survey. For all practical purposes consumption of tuna is synonymous with consumption of canned tuna. Consumer use of fresh, frozen, and cured tuna is insignificant. It amounts, combined, to an estimated .05 pounds per capita per year as compared to 1.5 pounds of canned tuna consumed in 1952. Nor is the outlook for increased consumption of the former products bright as will be discussed at a later point in this report. Hereafter in this chapter only canned tuna will be considered when discussing consumption. Wherever tuna consumption without qualification is mentioned, it will be synonymous with canned tuna consumption.

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[3] Unless otherwise noted "tuna" is used hereafter in this chapter to include albacore, bluefin, skipjack, yellowfin, and little tuna and bonito and yellowtail which are "tunalike" fishes. This is done in order to avoid repetition of the phrase "tuna and tunalike fishes".

A comparison of data on consumption of tuna and of other protein foods and of over-all fish consumption reveals just how tuna fits into the general protein food consumption picture. Table 2 shows per capita consumption of meat, fish, poultry, eggs, and cheese from 1909 through 1952. Although there are many ups and downs in the various series of data it will be noted that there has been, in recent years, a relatively high abundance of competitive protein foods such as meats of various kinds, poultry, eggs, and cheese.

The degree of abundance will register more strikingly upon an inspection of table 3 which shows the net food supply per person in various countries of the world. The section of that table which shows the percentage of total calories consumed per day obtained from livestock production indicates that the United States and New Zealand are the leading nations of the world in this respect in the most recent years shown in the table.

The abundance of other competing protein foods as shown in table 2 reacts to the disadvantage of the marketing of fish in general and has a like effect on the marketing of tuna. It can also be seen from table 2 just how small fish consumption, and tuna consumption in particular, is compared to the other principal protein foods. Unfortunately, the various statistics are not calculated on exactly comparable bases. Meat consumption is given in carcass weight, from which there is considerable waste such as bones and trimmings. Fish consumption is given on an edible weight basis. Poultry consumption is given on a dressed weight basis (uneviscerated). Egg consumption is given on a farm weight basis and cheese consumption on a primary market weight basis. To get all fish consumption as near to the bases of the other items in the table as possible the data for fish should be increased 30 percent as studies of the Fish and Wildlife Service indicate that the marketed weight of all fish is about that much greater than the edible weight. Using this conversion factor on the 1952 data for total fish consumption (edible weight) would result in about 15 pounds per capita on a marketed weight basis. This is still a relatively small item compared to meat and the total of all other non-fish items in the table. As for tuna, the marketed weight is the same as the edible weight. The round weight or live weight of tuna consumed in the United States would have amounted to about 3.4 pounds per capita in 1952.

So it can be seen that while this Nation consumes a great amount of protein, a relatively small share is obtained from fishery resources. Far

Table 2. - MEAT, FISH, POULTRY, EGGS, AND CHEESE: PER CAPITA CONSUMPTION, 1909 - 1952 1/

YEAR	MEAT (CARCASS WEIGHT) 2/					FISH (EDIBLE WEIGHT EQUIVALENT)	
	BEEF	VEAL	LAMB AND MUTTON	PORK	TOTAL MEAT	FRESH AND FROZEN	CANNED ALL
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1909. . .	73.5	7.2	6.7	66.4	153.8	4.3	2.7
1910. . .	69.8	7.1	6.4	61.8	145.1	4.5	2.8
1911. . .	67.9	7.0	7.3	68.4	150.6	4.8	2.8
1912. . .	64.0	6.9	7.6	66.2	144.7	5.0	2.9
1913. . .	62.8	6.2	7.2	66.3	142.5	5.3	2.9
1914. . .	61.5	5.7	7.1	64.6	138.9	5.6	3.0
1915. . .	56.0	5.8	6.0	66.1	133.9	5.8	2.4
1916. . .	58.4	6.4	5.8	68.4	139.0	6.0	2.2
1917. . .	64.2	7.1	4.4	58.5	134.2	6.2	2.0
1918. . .	68.0	7.2	4.7	60.6	140.5	6.4	2.0
1919. . .	61.0	7.8	5.6	63.4	137.8	6.4	2.8
1920. . .	58.6	7.9	5.4	63.1	135.0	6.3	3.2
1921. . .	55.1	7.5	6.1	64.3	133.0	6.2	2.2
1922. . .	58.6	7.7	5.1	65.3	136.7	6.1	3.2
1923. . .	59.2	8.1	5.3	73.7	146.3	6.0	2.9
1924. . .	59.1	8.5	5.2	73.5	146.3	6.1	3.3
1925. . .	59.1	8.5	5.2	66.3	139.1	6.3	3.2
1926. . .	59.8	8.1	5.4	63.7	137.0	6.6	3.4
1927. . .	54.1	7.3	5.3	67.3	134.0	7.0	3.8
1928. . .	48.4	6.4	5.5	70.5	130.8	7.1	3.9
1929. . .	49.3	6.3	5.6	69.2	130.4	6.9	3.9
1930. . .	48.6	6.4	6.7	66.6	128.3	5.9	3.3
1931. . .	48.3	6.6	7.1	67.9	129.9	5.0	3.2
1932. . .	46.4	6.5	7.0	70.3	130.2	4.4	3.4
1933. . .	51.2	7.1	6.7	70.3	135.3	4.2	3.9
1934. . .	63.5	9.3	6.3	64.0	143.1	4.4	4.2
1935. . .	52.9	8.5	7.2	48.1	116.7	5.2	4.7
1936. . .	60.1	8.3	6.6	54.8	129.8	5.2	5.8
1937. . .	54.8	8.6	6.6	55.4	125.4	5.6	4.2
1938. . .	54.0	7.6	6.8	57.8	126.2	5.3	4.8
1939. . .	54.4	7.5	6.6	64.3	132.8	5.4	4.6
1940. . .	54.7	7.4	6.6	73.0	141.7	5.7	4.2
1941. . .	60.4	7.6	6.8	67.9	142.7	6.3	4.7
1942. . .	60.8	8.2	7.2	63.3	139.5	5.3	2.2
1943. . .	52.9	8.2	6.4	78.5	146.0	5.6	1.9
1944. . .	55.3	12.3	6.6	79.1	153.3	5.6	2.6
1945. . .	59.0	11.8	7.3	66.2	144.3	7.1	2.6
1946. . .	61.3	9.9	6.6	75.4	153.2	6.2	3.8
1947. . .	69.1	10.8	5.3	69.1	154.3	6.2	3.6
1948. . .	62.7	9.5	5.0	67.4	144.6	6.3	3.8
1949. . .	63.5	8.8	4.1	67.3	143.7	6.4	4.1
1950 9/ .	63.0	8.0	3.9	68.6	143.5	6.3	4.3
1951 9/ .	56.1	6.6	3.4	71.5	137.6	6.4	4.2
1952 9/ .	60.4	7.0	3.9	70.7	142.0	6.3	4.2

YEAR	FISH (EDIBLE WEIGHT EQUIVALENT) CONTINUED			POULTRY DRESSED 3/			
	TUNA 7/	CURED	TOTAL FISH	CHICKEN	TURKEY	EGGS	CHEESE
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1909. . .	(8)	3.9	10.9	19.4	(8)	36.2	3.9
1910. . .	(8)	3.8	11.1	20.4	(8)	37.9	4.3
1911. . .	(8)	3.6	11.2	20.7	(8)	40.8	4.1
1912. . .	(8)	3.5	11.4	19.7	(8)	38.6	4.0
1913. . .	(8)	3.4	11.6	19.2	(8)	37.6	4.4
1914. . .	.2	3.3	11.9	19.1	(8)	36.6	4.4
1915. . .	.2	3.2	11.4	19.1	(8)	38.9	4.3
1916. . .	.2	3.0	11.2	18.3	(8)	37.1	4.0
1917. . .	.2	2.9	11.1	17.5	(8)	34.9	3.9

(CONTINUED ON NEXT PAGE)

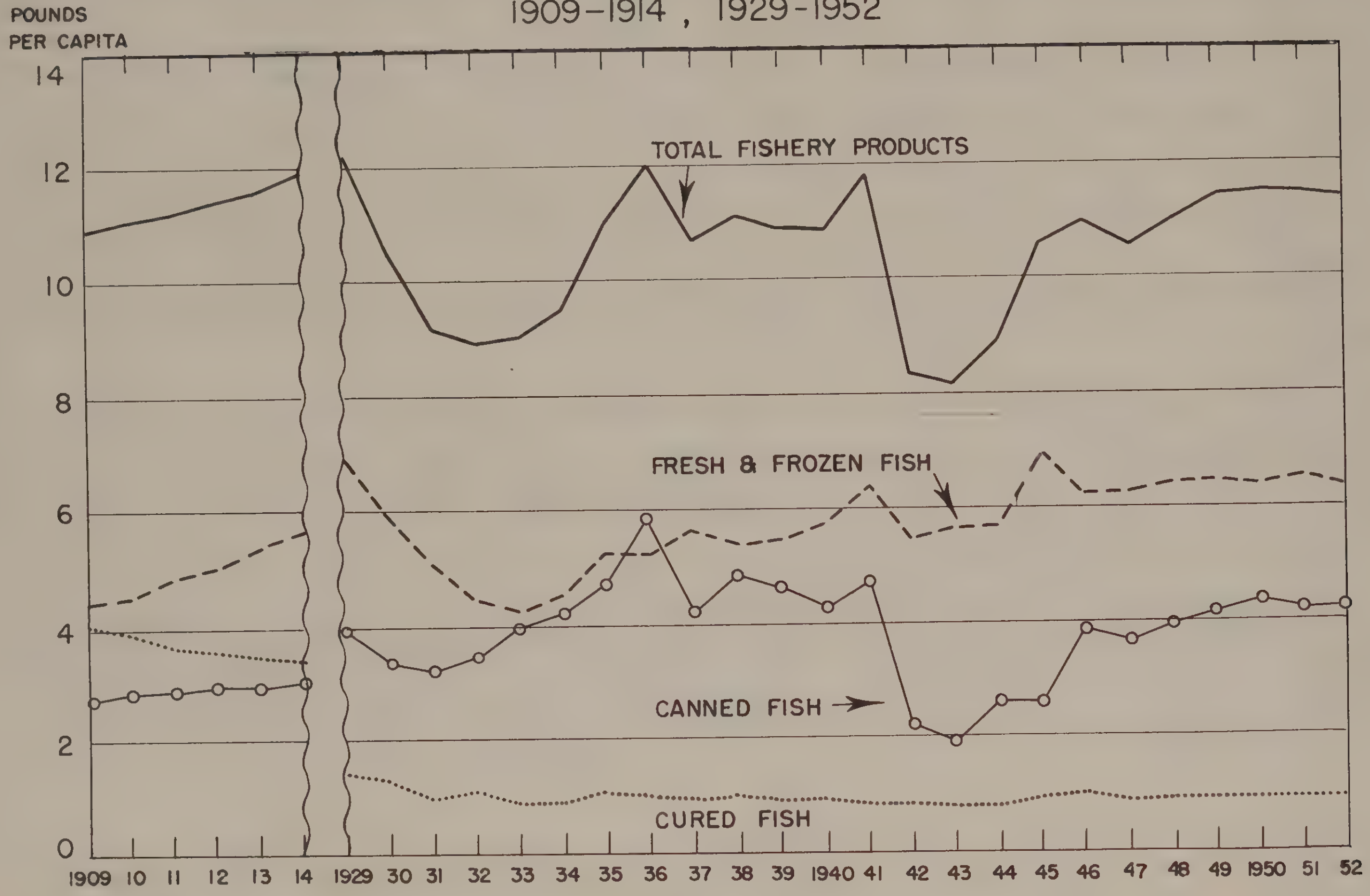
Table 2. - MEAT, FISH, POULTRY, EGGS, AND CHEESE: PER CAPITA CONSUMPTION, 1909 - 1952 1/- Continued

YEAR	FISH (EDIBLE WEIGHT EQUIVALENT) CONTINUED			POULTRY DRESSED 3/			
	TUNA 7/	CURED	TOTAL FISH	CHICKEN	TURKEY	EGGS	CHEESE
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1918. . .	.2	2.8	11.2	17.6	(8)	35.2	3.8
1919. . .	.2	2.7	11.9	18.8	(8)	37.6	4.2
1920. . .	.2	2.5	12.0	18.1	(8)	37.1	4.1
1921. . .	.2	2.4	10.8	17.7	(8)	37.1	4.1
1922. . .	.2	2.3	11.6	18.7	(8)	39.1	4.3
1923. . .	.2	2.2	11.1	19.3	(8)	40.5	4.3
1924. . .	.2	2.0	11.4	19.1	(8)	40.2	4.5
1925. . .	.2	1.9	11.4	19.7	(8)	39.5	4.6
1926. . .	.2	1.8	11.8	19.6	(8)	42.0	4.6
1927. . .	.3	1.7	12.5	20.9	(8)	42.5	4.4
1928. . .	.3	1.5	12.5	20.0	(8)	42.0	4.4
1929. . .	.3	1.4	12.2	19.7	1.7	41.5	4.6
1930. . .	.3	1.3	10.5	21.5	1.8	41.1	4.6
1931. . .	.2	1.0	9.2	19.4	1.7	41.4	4.4
1932. . .	.2	1.1	8.9	19.7	2.1	38.9	4.3
1933. . .	.4	.9	9.0	20.3	2.4	36.9	4.5
1934. . .	.4	.9	9.5	18.8	2.2	35.9	4.8
1935. . .	.5	1.1	11.0	18.1	2.1	34.8	5.2
1936. . .	.5	1.0	12.0	18.1	2.7	35.9	5.3
1937. . .	.6	.9	10.7	18.0	2.7	38.2	5.5
1938. . .	.5	1.0	11.1	16.8	2.7	38.5	5.8
1939. . .	.7	.9	10.9	18.7	3.0	38.9	5.9
1940. . .	.7	.9	10.8	18.7	3.5	39.6	6.0
1941. . .	.5	.8	11.8	20.5	3.5	38.6	5.9
1942. . .	.4	.8	8.3	23.4	3.7	39.5	6.4
1943. . .	.4	.7	8.2	30.5	3.3	43.1	4.9
1944. . .	.5	.7	8.9	27.0	3.3	44.0	4.8
1945. . .	.7	.9	10.6	28.7	4.2	50.0	6.6
1946. . .	.7	1.0	11.0	25.7	4.5	47.1	6.7
1947. . .	.9	.8	10.6	23.5	4.4	47.6	6.9
1948. . .	.9	.9	11.0	23.1	3.7	48.3	6.9
1949. . .	1.0	.9	11.4	25.1	4.1	47.7	7.2
1950. . .	1.2	.9	11.5	26.4	4.9	48.2	7.7
1951. . .	1.4	.9	11.5	28.8	5.2	51.6	7.2
1952. . .	1.5	.9	11.4	29.5	5.6	52.7	7.5

1/ CIVILIAN CONSUMPTION ONLY BEGINNING IN 1941.
2/ APPROXIMATELY AT WHOLESALE LEVEL OF DISTRIBUTION.
3/ DRESSED WEIGHT, (NEW YORK STYLE) APPROXIMATELY AT WHOLESALE LEVEL OF DISTRIBUTION.
4/ CANNED FISH CONSUMPTION ESTIMATED 1910 - 20 BASED ON STRAIGHT LINE TREND PROJECTION, ADJUSTED FOR LARGE EXPORT AND MILITARY TAKINGS OF CANNED FISH FROM 1915 - 1918.
5/ FARM WEIGHT BUT MEASURED APPROXIMATELY AT WHOLESALE LEVEL OF DISTRIBUTION.
6/ WHOLE AND PART WHOLE MILK CHEESE, EXCLUDES FULL SKIM, COTTAGE, POT, AND BAKERS.
7/ TUNA AND TUNALIKEFISHES.
8/ NOT AVAILABLE.
9/ PRELIMINARY
SOURCE:- UNITED STATES FISH AND WILDLIFE SERVICE AND UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS.

Figure 2

CIVILIAN PER CAPITA CONSUMPTION OF FISHERY PRODUCTS, UNITED STATES, 1909-1914, 1929-1952



Data from table 2.

U. S. FISH AND WILDLIFE SERVICE

Table 3. - NET FOOD SUPPLY PER PERSON

CONTINENT AND COUNTRY	PERIOD 1/	CEREALS 2/ AS FLOUR	POTATOES 3/ AND OTHER ROOT CROPS	SUGAR	PULSES 5/
EUROPE		. . . .	. . KILOGRAMS PER YEAR . .		. . . . .
AUSTRIA	PREWAR	138	96	24	2
	1948/49	142	113	23	2
	1949/50	127	106	23	1
BELGIUM LUXEMBOURG	PREWAR	115	157	28	5
	1948/49	104	141	26	2
	1949/50	106	144	29	2
CZECHOSLOVAKIA	1948/49	139	145	23	3
DENMARK	PREWAR	94	120	50	-
	1948/49	108	137	32	1
	1949/50	107	138	31	1
FINLAND	PREWAR	128	181	28	3
	1948/49	145	184	25	3
	1949/50	118	137	29	2
FRANCE	PREWAR	124	143	24	4
	1948/49	125	142	19	3
	1949/50	117	129	23	3
GERMANY, TOTAL	PREWAR	113	176	24	2
FED. REPUBLIC	1948/49	124	228	19	5
	1949/50	113	203	23	2
SOVIET ZONE	1948/49	141	218	23	2
	1949/50	141	197	20	3
GREECE	PREWAR	163	14	10	12
	1948/49	158	31	9	10
	1949/50	147	39	9	10
ICELAND	PREWAR	120	70	44	1
	1948/49	105	76	35	1
IRELAND	PREWAR	131	195	38	1
	1948/49	135	194	33	1
	1949/50	135	188	35	2
ITALY	PREWAR	164	37	7	13
	1948/49	154	38	10	8
	1949/50	153	33	11	6
NETHERLANDS	PREWAR	107	116	32	3
	1948/49	100	175	39	2
	1949/50	94	171	38	2
NORWAY	PREWAR	119	130	30	2
	1948/49	122	136	22	3
	1949/50	116	123	25	3
POLAND	PREWAR	134	285	9	9
	1948/49	148	240	16	2
SWEDEN	PREWAR	95	122	43	2
	1948/49	86	157	40	2
	1949/50	87	117	47	2
SWITZERLAND	PREWAR	110	90	38	2
	1948/49	112	98	38	1
	1949/50	120	84	37	1

(CONTINUED ON NEXT PAGE)

Table 3. - NET FOOD SUPPLY PER PERSON - Continued

CONTINENT AND COUNTRY	PERIOD 1/	CEREALS 2/ AS FLOUR	POTATOES 3/ AND OTHER ROOT CROPS	SUGAR	PULSES 5/
		. . . .	. . KILOGRAMS PER YEAR . .	. .	. . . . .
EUROPE - CONTINUED:					
UNITED KINGDOM	PREWAR	94	79	48	3
	1948/49	112	115	38	2
	1949/50	103	115	35	3
NORTH AND CENTRAL AMERICA					
CANADA	PREWAR	93	90	43	4
	1948/49	72	98	45	4
	1949/50	75	93	45	4
CUBA	PREWAR	102	8/ 99	40	12
	1948/49	106	8/ 91	40	16
UNITED STATES	PREWAR	90	64	44	4
	1948/49	77	50	40	4
	1949/50	77	50	40	4

CONTINENT AND COUNTRY	PERIOD 1/	MEATS 5/	MILK 6/	FATS AND OILS (FAT CONTENT)	CALORIES PER DAY	
					TOTAL	PERCENTAGE FROM LIVESTOCK PRODUCTS 7/
		KILOGRAMS	PER YEAR	. . . . .	NUMBER	PERCENT
EUROPE						
AUSTRIA	PREWAR	49	199	18	2,990	32
	1948/49	23	105	14	2,640	22
	1949/50	30	139	15	2,610	27
BELGIUM-LUXENBOURG	PREWAR	46	136	19	2,820	29
	1948/49	45	139	19	2,730	32
	1949/50	43	150	21	2,890	31
CZECHOSLOVAKIA	1948/49	34	105	10	2,690	22
DENMARK	PREWAR	75	195	27	3,420	35
	1948/49	64	205	15	3,060	36
	1949/50	65	210	19	3,180	39
FINLAND	PREWAR	33	276	13	3,000	31
	1948/49	27	271	12	3,070	30
	1949/50	28	267	19	3,020	38
FRANCE	PREWAR	53	150	14	2,830	26
	1948/49	54	139	11	2,690	26
	1949/50	57	148	11	2,680	28
GERMANY, TOTAL	PREWAR	51	151	23	2,960	37
FED. REPUBLIC	1948/49	18	92	9	2,530	19
	1949/50	31	134	16	2,690	26
SOVIET ZONE	1948/49	13	62	5	2,410	12
	1949/50	19	69	7	2,460	15
GREECE	PREWAR	20	75	15	2,600	12
	1948/49	11	43	15	2,470	8
	1949/50	12	64	16	2,490	10
ICELAND	PREWAR	51	313	15	3,160	36
	1948/49	80	390	19	3,230	44
IRELAND	PREWAR	55	149	14	3,390	35
	1948/49	54	185	17	3,350	35
	1949/50	53	181	19	3,450	36

(CONTINUED ON NEXT PAGE)

Table 3. - NET FOOD SUPPLY PER PERSON - Continued

CONTINENT AND COUNTRY	PERIOD 1/	MEATS 5/	MILK 6/	FATS AND OILS (FAT CONTENT)	CALORIES PER DAY	
					TOTAL	PERCENTAGE FROM LIVESTOCK PRODUCTS 7/
EUROPE - CONTINUED:		. . . . . KILOGRAMS PER YEAR		. . .	NUMBER	PERCENT
ITALY	PREWAR	20	74	11	2,510	14
	1948/49	17	77	9	2,340	15
	1949/50	17	81	10	2,370	15
NETHERLANDS	PREWAR	38	220	20	2,920	32
	1948/49	21	220	19	2,880	27
	1949/50	29	211	23	2,970	28
NORWAY	PREWAR	38	252	25	3,220	33
	1948/49	27	283	20	2,970	34
	1949/50	35	333	25	3,140	41
POLAND	PREWAR	26	135	7	2,710	23
	1948/49	19	114	6	2,620	17
SWEDEN	PREWAR	49	302	18	3,120	38
	1948/49	42	251	19	3,070	42
	1949/50	48	302	20	3,200	42
SWITZERLAND	PREWAR	56	307	15	3,110	35
	1948/49	40	337	14	3,100	32
	1949/50	45	340	15	3,190	33
UNITED KINGDOM	PREWAR	64	152	20	3,100	39
	1948/49	44	202	19	3,050	32
	1949/50	52	210	21	3,090	36
NORTH AND CENTRAL AMERICA						
CANADA	PREWAR	62	221	19	3,070	39
	1948/49	70	240	18	3,060	43
	1949/50	71	238	20	3,140	44
CUBA	PREWAR	33	79	8	2,610	17
	1948/49	35	90	11	2,730	21
UNITED STATES	PREWAR	64	204	20	3,150	36
	1948/49	74	238	19	3,140	45
	1949/50	76	245	20	3,170	45

CONTINENT AND COUNTRY	PERIOD 1/	CEREALS 2/ AS FLOUR	POTATOES 3 AND OTHER ROOT CROPS	SUGAR 4/	PULSES	MEATS 5/
SOUTH AMERICA		. . . . . .	. . . . KILOGRAMS PER YEAR		. . . .	. . . . . .
ARGENTINA	PREWAR	106	66	27	2	107
	1948/49	124	87	35	2	114
BRAZIL	PREWAR	78	8/ 91	25	20	50
	1948/49	79	8/ 123	30	22	39
CHILE	PREWAR	124	73	25	10	38
	1948/49	134	80	26	6	38
COLUMBIA	PREWAR	57	8/ 87	37	7	26
	1948/49	72	8/ 98	57	8	29

(CONTINUED ON NEXT PAGE)

Table 3. - NET FOOD SUPPLY PER PERSON - Continued

CONTINENT AND COUNTRY	PERIOD 1/	CEREALS 2/ AS FLOUR	POTATOES 3/ AND OTHER ROOT CROPS	SUGAR	PULSES	MEAT 5/
SOUTH AMERICA-CONTINUED:		. . . . . .	. . . . KILOGRAMS PER YEAR.		. . . . .	. . . . . .
URUGUAY	PREWAR	85	42	24	2	107
	1948/49	100	34	28	2	106
VENEZUELA	1949/50	85	58	43	14	21
ASIA						
BURMA	PREWAR	149	8/6	9	7	9
	1947/48	154	8/8	6	10	6
CEYLON	1948/49	102	8/38	13	4	2
	1949/50	108	8/33	15	6	3
CHINA (22 PROVINCES)	PREWAR	172	30	1	23	13
	1947/48	163	35	1	22	10
CYPRUS	PREWAR	169	21	9	9	12
	1948/49	171	42	10	11	17
INDIA	PREWAR 9/	143	8	13	18	3
	1948/49	110	6	12	17	2
	1949/50	117	-	10	-	2
INDOCHINA	PREWAR	144	8/24	7	4	14
	1947/48	152	8/58	6	7	4
INDONESIA						
JAVA & MADURA	PREWAR	128	8/157	6	3	5
ISRAEL	1949/50	130	40	26	3	18
PAKISTAN	1948/49	153	5	12	11	4
TURKEY	PREWAR	191	3	5	8	18
	1949/50	196	16	7	6	14
JAPAN	PREWAR	168	63	14	7	4
	1948/49 10/	148	60	6	1	2
	1949/50 10/	149	60	3	1	2
AFRICA						
EGYPT	PREWAR	182	5	13	19	7
	1948/49	186	12	15	12	19
	1949/50	164	10	14	12	10
MAURTIUS	1948/49	135	28	41	6	7
U. OF S. AFRICA	PREWAR	156	16	23	2	38
	1948/49	155	16	42	2	42
	1949/50	154	15	40	3	43
OCEANIA						
AUSTRALIA	PREWAR	101	49	53	1	120
	1948/49	95	53	53	1	110
	1949/50	96	53	53	2	112
NEW ZEALAND	PREWAR	87	50	48	2	109
	1948/49	90	49	50	1	96
	1949/50	92	37	50	2	106

(CONTINUED ON NEXT PAGE)

Table 3. - NET FOOD SUPPLY PER PERSON - Continued

CONTINENT AND COUNTRY	PERIOD 1/	MILK 6	FATS AND OILS (FAT CONTENT)	CALORIES PER DAY	
				TOTAL	PERCENTAGE FROM LIVESTOCK PRODUCTS 7/
SOUTH AMERICA		. . . .	. .KILOGRAMS PER YEAR. . .	. . . .	
ARGENTINA	PREWAR	163	9	2,730	36
	1948/49	165	16	3,190	32
BRAZIL	PREWAR	80	5	2,150	24
	1948/49	79	6	2,340	19
CHILE	PREWAR	54	5	2,240	16
	1948/49	68	6	2,350	17
COLOMBIA	PREWAR	93	3	1,860	19
	1948/49	144	3	2,280	19
URUGUAY	PREWAR	165	12	2,380	43
	1948/49	183	11	2,580	39
VENEZUELA	1949/50	107	5	2,210	18
ASIA					
BURMA	PREWAR	17	4	2,080	13
	1947/48	8	3	1,990	10
CEYLON	1948/49	9	4	1,920	5
	1949/50	13	4	1,800	6
CHINA	PREWAR	-	6	2,230	7
(22 PROVINCES)	1947/48	-	6	2,120	6
CYPRUS	PREWAR	48	9	2,350	9
	1948/49	41	10	2,500	10
INDIA	PREWAR 9/	65	3	1,970	8
	1948/49	46	3	1,620	7
	1949/50	45	3	-	-
INDOCHINA	PREWAR	13	2	1,900	11
	1947/48	-	2	2,040	4
INDONESIA					
JAVA & MADURA	PREWAR	1	3	2,040	2
ISRAEL	1949/50	105	16	2,680	12
PAKISTAN	1948/49	73	2	2,030	10
TURKEY	PREWAR	40	8	2,560	11
	1949/50	54	8	2,670	13
JAPAN	PREWAR	4	2	2,180	5
	1948/49 10/	3	1	10/2,050	3
	1949/50 10/	4	1	10/2,100	3
AFRICA					
EGYPT	PREWAR	31	5	2,450	8
	1948/49	27	5	2,480	8
	1949/50	29	6	2,300	10
MAURITIUS	1948/49	37	6	2,240	7
U. OF S. AFRICA	PREWAR	76	3	2,300	18
	1948/49	84	5	2,580	18
	1949/50	83	5	2,500	16

(CONTINUED ON NEXT PAGE)

Table 3. - NET FOOD SUPPLY PER PERSON - Continued

CONTINENT AND COUNTRY	PERIOD 1/	MILK 6/	FATS AND OILS (FAT CONTENT)	CALORIES PER DAY	
				TOTAL	PERCENTAGE FROM LIVESTOCK PRODUCTS 7/
OCEANIA		. . . . . .	..KILOGRAMS PER YEAR. . . .	. . . .	
AUSTRALIA	PREWAR	164	16	3,300	40
	1948/49	195	14	3,210	41
	1949/50	196	14	3,210	41
NEW ZEALAND	PREWAR	166	17	3,260	48
	1948/49	240	15	3,250	46
	1949/50	240	16	3,280	45

1/ PREWAR DATA REFER GENERALLY TO 1934-38 AVERAGE, WITH THE FOLLOWING EXCEPTIONS: 1935-1938 FOR GERMANY AND GREECE, 1936-38 FOR THE NETHERLANDS, 1936-38 FOR AUSTRALIA, 1935-39 FOR NEW ZEALAND, CANADA, UNITED STATES, ARGENTINA, BRAZIL, CHILE, COLOMBIA, URUGUAY, AND UNION OF SOUTH AFRICA, AND 1931-37 FOR CHINA.
2/ IN TERMS OF FLOUR AND MILLED RICE.
3/ INCLUDES SWEET POTATOES, CASSAVA, ETC.; POTATO FLOUR, MANIOC FLOUR, AND OTHER ROOT FLOUR EXPRESSED IN TERMS OF POTATOES, CASSAVA, ETC.
4/ IN TERMS OF REFINED SUGAR, EXCLUDING SYRUP AND HONEY.
5/ INCLUDING OFFAL AND POULTRY.
6/ WHOLE MILK USED FOR FRESH CONSUMPTION AND FOR OTHER DAIRY PRODUCTS EXCEPT BUTTER.
7/ INCLUDING MEAT, EGGS, FISH, MILK, CHEESE, BUTTER, SLAUGHTER FATS, AND MARINE OILS.
8/ MORE THAN 50 PERCENT DERIVED FROM ROOT CROPS OTHER THAN POTATOES AND SWEET POTATOES.
9/ INDIA AND PAKISTAN.
10/ FIGURES FOR COMMODITY EXCLUDE UNREPORTED CROP PRODUCTION, FOR WHICH ALLOWANCE IS MADE IN TOTAL CALORIES.

SOURCE: FOOD AND AGRICULTURE ORGANIZATION.

more protein comes from meat production. The near-term outlook is for plentiful supplies of meat so there is little possibility in the near future for fish consumption to make rapid increases as a result of shortages of other protein foods. This phenomenon did happen with fresh and frozen fish during World War II but it is not likely to occur in the near-term for over-all fish consumption or for any specific segment of the fisheries, such as tuna, unless another great war should develop.

But that is not to say that tuna consumption will not expand at all. On the contrary, there is every likelihood that it will, but for very different reasons. These reasons will be given later in this chapter together with an estimate of the extent tuna consumption can expand.

OVER-ALL FISH CONSUMPTION

After the foregoing comparison of tuna consumption with that of the principal protein foods a review of the utilization of all fish and the over-all picture of fish consumption in the United States is desirable. The volume of fish produced in the United States for food consumption since 1929 averaged, on a round weight basis, approximately 3 billion pounds annually. Although the catch has increased in both quantity and value, the annual per capita consumption of all fishery products has remained fairly constant. This may be noted by again referring to the data in table 2 and to figure 2. Several declines in consumption occurred during the past two decades but recoveries were made rapidly. There were lows of 8 to 9 pounds per capita consumption during the depression years of the early 1930's and during the World War II years of short supplies; but in both these cases the per capita consumption climbed back to over 11 pounds.

Although total fish consumption has remained about the same since 1909, the production and consumption of specific types of fishery products has undergone the marked changes shown in figure 2. The consumption of cured fish has declined over this period from 3.9 pounds per capita to less than one pound per capita. An increasingly larger share of the catch has been utilized in the fresh and frozen and canned categories. Since 1929 consumption of packaged fillets and steaks has tripled in volume. However, this amounts to little more than doubling of consumption on a per capita basis because of population growth. Improved methods of freezing, transporting, and marketing fish are responsible for the changed consumption patterns of these fishery products.

Long before frozen fish was on the market in the forms known today, canned fish was becoming more popular and consumed in greater quantities as the use of cured fish declined. Among all processed fishery products, the canned fishery products, are the most important in terms of both quantity and value. Consumption of canned fish in the United States has ranged from a high of 5.8 pounds per capita in 1936 to a low of 1.9 pounds in 1943. In the latter year, war needs diverted canned fish, particularly canned salmon, from civilian markets. After this diversion ceased, per capita consumption rose to 4.3 pounds in 1950, the highest since 1941.

With the growth in popularity of canned fish, and the availability of attractively packaged frozen fish the down-trend in consumption of cured fish has reached .9 pounds per capita and appears to have leveled off at this low point. Cured fish has been reduced to a specialty item, a reversal of the staple part this food played in the diet of many early Americans.

Canned fishery products are part of the diet of more household consumers in the United States than any other form of fishery product, according to a recent Fish and Wildlife Service survey. Canned fish has such advantages as easy storage and transportation without the need of refrigeration, and simple preparation by the consumer. Because of these advantages canned fish has a much wider geographic distribution than fresh or frozen fishery products. One of the publications issued in connection with the above-mentioned survey -- Fishery Leaflet 408, entitled Fish and Shellfish Preferences of Household Consumers - 1951, Part II - Regional Summary -- gives estimates of the percentages of households within a region which used various types of fishery products. Figure 3 is based on data taken from that publication. It shows that canned fish has the highest percentage of use nationally and in each of the four regions shown.

TUNA CONSUMPTION COMPARED WITH OTHER SPECIES

Most fishery products marketed in the United States for human food are consumed either in fresh, frozen or canned form. As has been shown in table 2 cured fishery products are a relatively minor item in our diet. Only a very small amount of domestically-caught salmon, cod, herring, sturgeon, and fresh-water fish are marketed after going through a curing process. A large portion of our cured fish consumption is from imported cured herring.

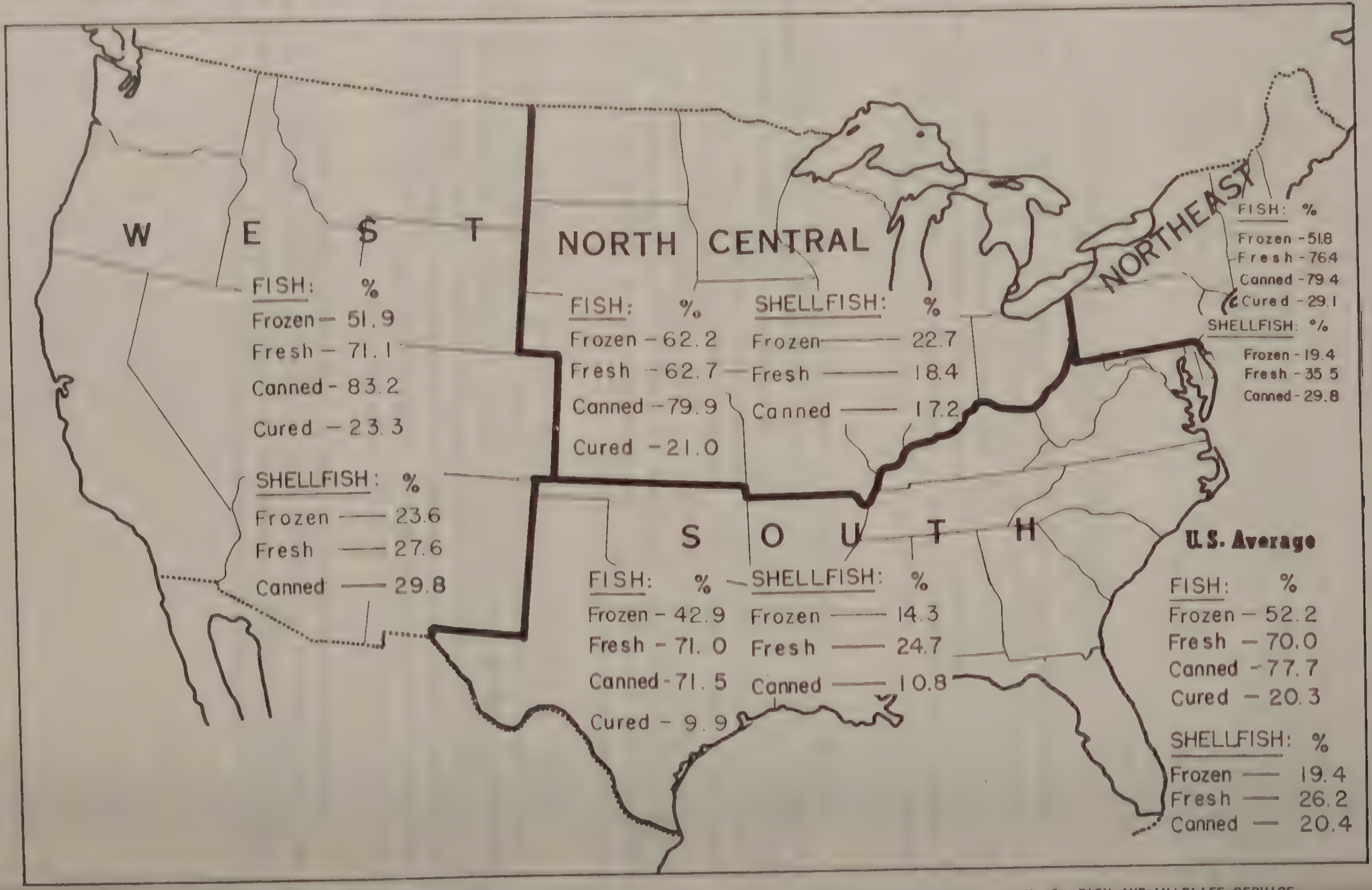
Since 1929 the domestic production of frozen fish has more than doubled. Imports have also increased even more. The development of packaged frozen fish led to the greater utilization of species such as ocean perch that are easily filleted and have a special appeal, particularly to inland consumers. Ocean perch fillets have become the most important species in this category, although in 1935 ocean perch was insignificant among the landings of food fish in the United States. Other species that have risen in importance in the frozen fishery products trade are whiting and shrimp.

Haddock, halibut, and salmon -- long time favorites in the fresh and frozen fishery products trade -- have tended to hold their levels of consumption while such species as alewife, shad and oysters have shown declining trends. While cod production in the United States for the fresh and frozen trade is now lower, as compared to pre-World War II years, there has been a complementary increase in importation of cod fillets into the United States from foreign sources.

As spectacular as the rise in the consumption of ocean perch, has been the increase in shrimp consumption in recent years. The total consumption of shrimp has increased markedly compared to pre-World War II years. Consumption of frozen shrimp has developed particularly at the expense of

Figure 3

ESTIMATED PERCENTAGE OF HOUSEHOLDS USING VARIOUS TYPES OF FISHERY PRODUCTS DURING THE YEAR PRIOR TO OCTOBER 1, 1951.[1]


WEST
FISH: %
Frozen — 51.9
Fresh — 71.1
Canned - 83.2
Cured — 23.3
SHELLFISH: %
Frozen —— 23.6
Fresh —— 27.6
Canned —— 29.8
NORTH CENTRAL
FISH: %
Frozen - 62.2
Fresh - 62.7
Canned - 79.9
Cured - 21.0
SHELLFISH: %
Frozen —— 22.7
Fresh —— 18.4
Canned —— 17.2
NORTHEAST
FISH: %
Frozen - 51.8
Fresh - 76.4
Canned - 79.4
Cured - 29.1
SHELLFISH: %
Frozen - 19.4
Fresh - 35.5
Canned - 29.8
SOUTH
FISH: %
Frozen - 42.9
Fresh - 71.0
Canned - 71.5
Cured - 9.9
SHELLFISH: %
Frozen —— 14.3
Fresh —— 24.7
Canned —— 10.8
U.S. Average
FISH: %
Frozen — 52.2
Fresh — 70.0
Canned — 77.7
Cured — 20.3
SHELLFISH: %
Frozen —— 19.4
Fresh —— 26.2
Canned —— 20.4

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the United States.

sales of fresh shrimp, and has more than doubled since the end of World War II. The increase in the supply, which occurred as a result of strong demand, resulted from expansion of domestic production and the sizable increases in imports from Mexico.

Among canned fish, salmon, tuna, and sardines account for the bulk of the domestic consumption. (table 4). During the period 1929 to 1938 salmon usually accounted for over one-half of the canned fish consumption in the United States. Canned salmon consumption has declined from over two pounds in pre-World War II years to an average of about 1.4 pounds in the post-World War II period. The salmon pack varies with the size of annual runs which have decreased appreciably in recent years. The decreases have been marked for red and pink salmon and to a lesser degree for the lower priced chum.

The picture for canned tuna consumption, however, is quite different from that of canned salmon. Tuna consumption presents a reversal of the canned salmon trend. Tuna has increased from a per capita consumption of only .5 pounds in 1935 to 1.5 pounds in 1952. The pack of the leading tuna species — albacore, yellowfin, and skipjack — increased considerably over the past two decades. The response of the domestic industry to increased demand has been an increased amount of processing on the part of tuna canners and increased fishing effort by the tuna fleet with long-range tuna clippers operating as far south as Peru. But at the same time increased imports of canned tuna and of frozen tuna used for canning in domestic canneries have accounted for increasing proportions of the supply available to American consumers.

The sardine packs of both Maine and California have also fluctuated considerably. The season just closed in California has been the most disastrous in history from a production standpoint. A significant portion of the pack, particularly that of California, is for the export market. It appears likely that the portion of the canned sardine pack used domestically will continue to rank after salmon and tuna in per capita consumption.

Reference to table 4 indicates that since 1929, with the exception of the World War II period, the per capita consumption for all canned fish has shown a slight increase. Far greater have been the per capita consumption changes among the species utilized for canning. Tuna consumption has increased steadily, while consumption of salmon and sardines, although fluctuating erratically, has declined.

Table 4. - CANNED FISH: PER CAPITA CONSUMPTION BY PRINCIPAL KINDS (EDIBLE WEIGHTS) 1909 - 1952 1/

YEAR	SALMON	SARDINES (PILCHARDS AND HERRING)	TUNA AND TUNALIKE FISHES	SHELLFISH	OTHER	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1909. . . .	1.5	.6	(2)	.2	.2	(2)
1910. . . .	1.5	.7	(2)	.2	.2	(2)
1911. . . .	1.5	.7	(2)	.2	.2	(2)
1912. . . .	1.6	.7	(2)	.2	.2	(2)
1913. . . .	1.6	.7	(2)	.2	.2	(2)
1914. . . .	1.6	.7	.2	.2	.3	3.0
1915. . . .	1.3	.6	.2	.2	.1	2.4
1916. . . .	1.2	.5	.2	.2	.1	2.2
1917. . . .	1.1	.5	.2	.2	(3)	2.0
1918. . . .	1.1	.5	.2	.2	(3)	2.0
1919. . . .	1.5	.7	.2	.2	.2	2.8
1920. . . .	1.7	.8	.2	.2	.3	3.2
1921. . . .	1.2	.5	.2	.2	.1	2.2
1922. . . .	1.7	.8	.2	.2	.3	3.2
1923. . . .	1.6	.7	.2	.2	.2	2.9
1924. . . .	1.8	.8	.2	.2	.3	3.3
1925. . . .	1.7	.8	.2	.2	.3	3.2
1926. . . .	1.8	.8	.2	.2	.4	3.4
1927. . . .	2.1	.9	.3	.2	.3	3.8
1928. . . .	2.1	.9	.3	.2	.4	3.9
1929. . . .	2.1	.9	.3	.2	.4	3.9
1930. . . .	2.0	.7	.3	.2	.1	3.3
1931. . . .	2.1	.5	.2	.2	.2	3.2
1932. . . .	2.2	.5	.2	.2	.3	3.4
1933. . . .	2.2	.8	.4	.2	.3	3.9
1934. . . .	2.3	.8	.4	.2	.5	4.2
1935. . . .	2.2	1.0	.5	.2	.8	4.7
1936. . . .	3.4	1.1	.5	.2	.6	5.8
1937. . . .	1.9	1.0	.6	.3	.4	4.2
1938. . . .	2.9	.7	.5	.2	.5	4.8
1939. . . .	2.1	1.2	.7	.2	.4	4.6
1940. . . .	1.9	.7	.7	.2	.7	4.2
1941. . . .	4/2.8	5/.7	.5	.2	.5	4.7
1942. . . .	4/1.6	(3)	.4	.2	-	2.2
1943. . . .	.8	.4	.4	.2	.1	1.9
1944. . . .	.7	.9	.5	.1	.4	2.6
1945. . . .	.8	.8	.7	.1	.2	2.6
1946. . . .	1.1	1.2	.7	.2	.6	3.8
1947. . . .	1.5	.6	.9	.1	.5	3.6
1948. . . .	1.4	1.0	.9	.2	.3	3.8
1949 6/ . .	1.5	1.0	1.0	.2	.4	4.1
1950 6/ . .	1.4	1.1	1.2	.2	.4	4.3
1951 6/ . .	1.3	.7	1.4	.2	.6	4.2
1952 6/ . .	1.4	.5	1.5	.3	.5	4.2

1/ CANNED FISH CONSUMPTION ESTIMATE 1910 - 1920 BASED ON STRAIGHT LINE TREND PROJECTION ADJUSTED FOR LARGE EXPORT AND MILITARY TAKINGS OF CANNED FISH FROM 1915 - 1918.
2/ NOT AVAILABLE.
3/ LESS THAN .05 POUNDS.
4/ MAY BE TOO LARGE; NO DATA AVAILABLE ON DEFENSE AND WAR TAKINGS, WHICH HAD BECOME SIGNIFICANT BY 1942.
5/ ASSUMED TO BE SAME AS IN 1940.
6/ PRELIMINARY.

SOURCE: UNITED STATES FISH AND WILDLIFE SERVICE AND UNITED STATES BUREAU OF AGRICULTURE ECONOMIC.

THE RELATIVE VOLUME OF VARIOUS FISHERY PRODUCTS FROM FOREIGN SOURCES FOR DOMESTIC CONSUMPTION

Reference has been made to the importance of imports of certain types of fishery products in the fish consumption pattern of the United States. There has been a considerable increase in the percentage of edible fishery products supplied by foreign sources in recent years, particularly frozen cod fillets and frozen tuna. Table 5 shows the share of civilian consumption of edible fish in the United States foreign producers have had in total and by types of products from 1930 through 1951, with 1952 data unavailable. Since pre-World War II years the percentage of total civilian consumption supplied by imports from foreign countries has approximately doubled. Data for 1952 are unavailable. Particular note should be made of the substantial increase in the percentage of foreign supply for the fresh and frozen category. This latter increase is due largely to the imports of groundfish fillets, particularly cod fillets.

Table 6 gives a full picture of the estimated percentages of the total apparent supply of canned tuna by source and type for the years 1926 through 1952. This table does not take into account beginning and year end stocks, but it is felt that this does not significantly affect the data in the table which show the relative portions of apparent supply coming from different sources. Fresh and frozen tuna imports from foreign countries amounted to 16.2 percent of the total apparent supply of canned tuna in 1952, while in 1938 they amounted to only 3.6 percent. Canned tuna imports from foreign sources were 20.3 percent of the total apparent supply in 1950 just prior to the automatic doubling of the duty to 45 percent ad valorem on tuna canned in oil on January 1, 1951. Although this percentage was not as great as the 29.3 percent in 1933 the actual volume entered in 1950 was greater than that of 1933 when total supply and consumption were much less. With the 45 percent ad valorem duty in effect, tuna canned in oil has now declined to pre-World War II levels in absolute quantities imported and the percentage of the total apparent supply also has declined. New on the market as a volume product, tuna canned in brine, which is subject to a 12½ percent ad valorem duty, was beginning to be imported in significant amounts in 1951.

Of the total apparent supply of canned tuna in 1952, 33.3 percent was supplied by imports of fresh and frozen tuna and tuna canned in oil and in brine. In 1933 the percentage was 34.5, but the apparent supply was less than one-quarter that in 1952.

Table 5. - EDIBLE FISH: ESTIMATED CIVILIAN CONSUMPTION, ESTIMATED FOREIGN SUPPLY AND ESTIMATED PERCENT OF CIVILIAN CONSUMPTION SUPPLIED FROM FOREIGN SOURCES IN TOTAL AND BY TYPES OF PRODUCT (EDIBLE WEIGHT IN MILLIONS OF POUNDS) 1930 - 1952

YEAR	FRESH AND FROZEN 1/			CANNED 2/		
	CIVILIAN CONSUMPTION	FOREIGN SUPPLY	FOREIGN SUPPLY	CIVILIAN CONSUMPTION	FOREIGN SUPPLY	FOREGIN SUPPLY
	QUANTITY	QUANTITY	PERCENT	QUANTITY	QUANTITY	PERCENT
1930. . .	727.4	61.3	8.4	414.3	54.3	13.1
1931. . .	619.7	58.4	9.4	397.5	55.3	13.9
1932. . .	548.9	44.9	8.2	420.9	79.0	18.7
1933. . .	534.6	52.5	9.8	491.9	84.1	17.1
1934. . .	556.1	54.3	9.8	538.5	69.2	12.9
1935. . .	661.1	64.6	9.7	601.1	83.3	13.9
1936. . .	674.3	75.7	11.2	746.9	93.0	12.5
1937. . .	730.1	84.1	11.5	550.7	86.0	15.6
1938. . .	696.3	71.1	10.2	630.9	55.7	8.8
1939. . .	713.2	82.0	11.5	607.8	80.5	13.2
1940. . .	762.3	83.7	11.0	551.3	45.0	8.2
1941. . .	838.2	75.5	9.0	627.1	50.5	8.1
1942. . .	699.7	70.8	10.1	290.2	37.0	12.7
1943. . .	722.7	79.4	11.0	241.7	45.7	18.9
1944. . .	723.9	86.7	12.0	332.2	47.2	14.2
1945. . .	918.4	121.9	13.3	334.5	54.2	16.2
1946. . .	870.4	126.9	14.6	526.2	95.1	18.1
1947 3/ .	893.6	119.7	13.4	554.0	76.5	14.1
1948 3/ .	914.0	159.2	17.4	557.4	89.3	16.0
1949 3/ .	944.6	158.0	16.7	611.9	76.2	12.5
1950 3/ .	955.6	220.2	23.0	646.7	144.7	22.4
1951 3/ .	973.6	248.1	25.5	641.2	119.0	18.6
1952. . .	(4)	(4)	(4)	(4)	(4)	(4)

YEAR	CURED			TOTAL		
	CIVILIAN CONSUMPTION	FOREIGN SUPPLY	FOREIGN SUPPLY	CIVILIAN CONSUMPTION	FOEIGN SUPPLY	FOREIGN SUPPLY
	QUANTITY	QUANTITY	PERCENT	QUANTITY	QUANTITY	PERCENT
1930. . .	162.2	72.3	44.6	1,303.9	187.9	14.4
1931. . .	130.4	64.2	49.2	1,147.6	177.9	15.5
1932. . .	133.5	48.6	36.4	1,103.3	172.5	15.6
1933. . .	117.1	43.1	36.8	1,143.6	179.7	15.7
1934. . .	117.7	43.2	36.7	1,212.3	166.7	13.8
1935. . .	136.8	45.7	33.4	1,399.0	193.6	13.8
1936. . .	129.9	50.8	39.1	1,551.1	219.5	14.2
1937. . .	121.9	47.9	39.3	1,402.7	218.0	15.5
1938. . .	124.7	46.8	37.5	1,451.9	173.6	12.0
1939. . .	115.5	40.1	34.7	1,436.5	202.6	14.1
1940. . .	114.1	39.8	34.9	1,427.7	168.5	11.8
1941. . .	110.1	37.6	34.2	1,575.4	163.6	10.4
1942. . .	99.6	42.5	42.7	1,089.5	150.3	13.9
1943. . .	96.7	54.5	56.4	1,061.1	179.6	16.9
1944. . .	94.1	60.2	64.0	1,150.2	194.1	17.9
1945. . .	113.0	64.4	57.0	1,365.9	240.5	17.6
1946. . .	190.5	77.3	40.6	1,587.1	299.3	18.9
1947 3/ .	110.5	46.3	41.9	1,548.1	242.5	15.7
1948 3/ .	131.9	69.1	52.4	1,603.3	317.6	19.8
1949 3/ .	134.4	73.7	54.3	1,690.9	307.9	18.2
1950 3/ .	138.5	77.5	56.0	1,740.8	442.4	25.4
1951 3/ .	143.6	81.8	56.9	1,758.4	448.9	25.5
1952. . .	(4)	(4)	(4)	(4)	(4)	(4)

1/ SMALL QUANTITIES OF FRESH AND FROZEN SALMON USED IN CANNING INCLUDED AS DATA CANNOT BE SEGREGATED

2/ INCLUDES FRESH AND FROZEN TUNA AND FRESH SEA HERRING IMPORTED FOR CANNING, BUT EXCLUDES FRESH AND FROZEN SALMON IMPORTED FOR THAT PURPOSE.

3/ PRELIMINARY.

4/ NOT AVAILABLE.

SOURCE: COMPILED BY UNITED STATES FISH AND WILDLIFE SERVICE.

Table 6. - CANNED TUNA AND TUNALIKE FISHES: TOTAL APPARENT UNITED STATES SUPPLY AND ESTIMATED PERCENTAGES OF TOTAL APPARENT UNITED STATES SUPPLY BY SOURCE AND TYPE OF PRODUCT, 1926 - 1952 1/

YEAR	TOTAL APPARENT SUPPLY		PACKED IN U.S. FROM DOMESTIC CATCH
	THOUNSANDS OF POUNDS	PERCENT	PERCENT
1926	20,429	100.0	100.0
1927	30,140	100.0	99.8
1928	29,189	100.0	93.1
1929	36,103	100.0	90.2
1930	48,255	100.0	92.5
1931	30,144	100.0	84.1
1932	34,893	100.0	76.0
1933	49,017	100.0	65.5
1934	55,163	100.0	79.7
1935	68,445	100.0	83.9
1936	71,181	100.0	86.9
1937	86,521	100.0	80.9
1938	73,291	100.0	86.6
1939	97,557	100.0	86.6
1940	107,231	100.0	92.3
1941	64,895	100.0	94.3
1942	52,912	100.0	98.0
1943	57,074	100.0	98.9
1944	73,348	100.0	94.6
1945	94,230	100.0	93.6
1946	98,627	100.0	94.5
1947 5/	123,617	100.0	94.1
1948 5/	148,290	100.0	92.3
1949 5/	154,339	100.0	88.6
1950 5/	219,720	100.0	70.4
1951 5/	180,734	100.0	71.6
1952 5/	216,621	100.0	66.7

YEAR	FROM FOREIGN - CAUGHT FISH			
	PACKED IN U.S. FROM DOMESTIC FRESH OR FROZEN TUNA 2/	IMPORTED CANNED TUNA & TUNALIKE FISH IN OIL	IMPORTED CANNED TUNA IN BRINE 3/	TOTAL FOREIGN
	PERCENT	PERCENT	PERCENT	PERCENT
1926	-	(4)	-	-
1927	0.2	(4)	-	0.2
1928	6.9	(4)	-	6.9
1929	9.8	(4)	-	9.8
1930	7.5	(4)	-	7.5
1931	12.8	3.1	-	15.9
1932	7.0	17.0	-	24.0
1933	5.2	29.3	-	34.5
1934	5.9	14.4	-	20.3
1935	4.1	12.0	-	16.1
1936	3.5	9.6	-	13.1
1937	6.3	12.8	-	19.1
1938	3.6	9.8	-	13.4
1939	3.0	10.4	-	13.4
1940	1.4	6.3	-	7.7
1941	0.6	5.1	-	5.7
1942	1.2	0.8	-	2.0
1943	0.2	0.9	-	1.1
1944	1.1	4.3	-	5.4
1945	0.8	5.6	-	6.4
1946	0.7	4.8	-	5.5
1947 5/	0.9	5.0	-	5.9
1948 5/	1.9	5.8	(6)	7.7
1949 5/	3.2	8.1	0.1	11.4

(CONTINUED ON NEXT PAGE)

Table 6. - CANNED TUNA AND TUNALIKE FISHES: TOTAL APPARENT UNITED STATES SUPPLY AND ESTIMATED PERCENTAGES OF TOTAL APPARENT UNITED STATES SUPPLY BY SOURCE AND TYPE OF PRODUCT, 1926 - 1952 1/ - Continued

YEAR	FROM FOREIGN - CAUGHT FISH			
	PACKED IN U.S. FROM DOMESTIC FRESH OR FROZEN TUNA 2/	IMPORTED CANNED TUNA & TUNALIKE FISH IN OIL	IMPORTED CANNED TUNA IN BRINE 3/	TOTAL FOREIGN
	PERCENT	PERCENT	PERCENT	PERCENT
1950 5/	9.1	20.3	0.2	29.6
1951 5/	15.5	7.7	5.2	28.4
1952 5/	16.2	8.3	8.8	33.3

1/ PRIOR TO 1952 DOES NOT INCLUDE HAWAIIAN PACK FOR WHICH DATA WERE NOT GENERALLY AVAILABLE. ALSO BEGINNING AND YEAR-END STOCKS FOR EACH YEAR NOT CONSIDERED.
2/ CONVERTED TO NET WEIGHT OF CANNED FISH BY CONSIDERING A 45% RECOVERY FROM FRESH AND FROZEN WEIGHT SHOWN IN IMPORT STATISTICS. EXCEPT 1952 FOR WHICH 50.7% RECOVERY WAS USED. DATA FOR THE YEARS 1937-1950 EXCLUDE 90% OF THE IMPORTS SHOWN FROM COSTA RICA AND 60% OF THOSE FROM THE CANAL ZONE, BELIEVED TO REPRESENT AN APPROXIMATE PROPORTION OF THE TUNA CAUGHT BY UNITED STATES FISHING VESSELS AND TRANS SHIPPED TO THE UNITED STATES WHERE IT ENTERED AS AN IMPORT.
3/ DATA NOT AVAILABLE PRIOR TO 1948. PROBABLY INSIGNIFICANT.
4/ NOT SEPARATELY CLASSIFIED IN IMPORT DATA AND PROBABLY INSIGNIFICANT.
5/ PRELIMINARY
6/ LESS THAN .05 PERCENT.
SOURCE: COMPILED BY UNITED STATES FISH AND WILDLIFE SERVICE.

For 1950 and 1951 the percentage of the domestic market for canned tuna which was supplied by foreign sources has been much greater than the average for all canned fish. This is indicated by comparing the data on canned fish shown in table 5 with the data in table 6. It is likely that this situation has prevailed probably to an even greater extent in 1952 since the percentage of foreign supply of canned tuna rose even further in that year. The greater incidence of foreign supply in the canned tuna market as compared to the average for all canned fish is also illustrated graphically in figure 4.

SPECIAL ASPECTS OF CONSUMER DEMAND FOR TUNA IN THE UNITED STATES

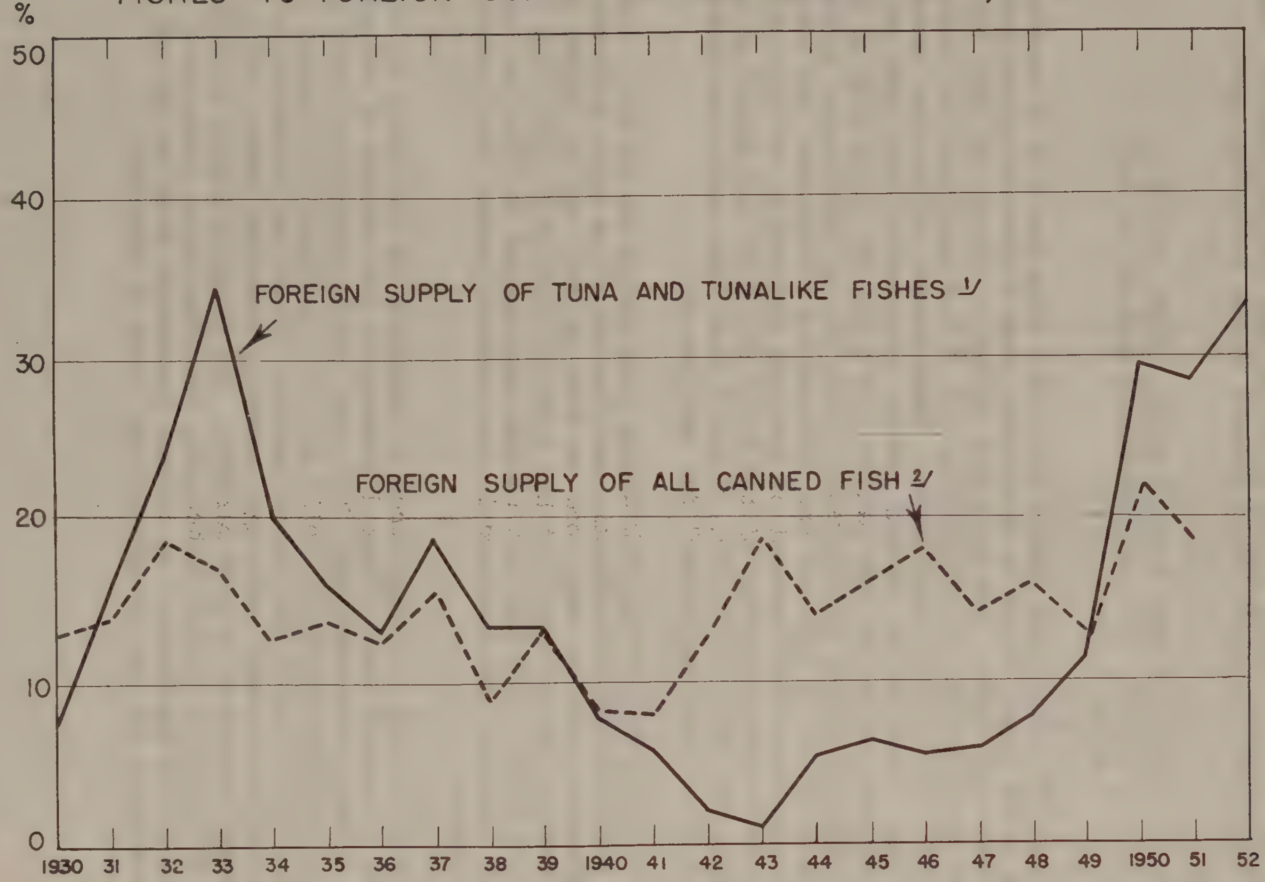
Besides drawing together historical data on consumption in the immediately preceding pages, there were numerous special aspects of domestic demand for tuna which required investigation. Canned fish processors, distributors, and the consumers were interviewed to determine various special characteristics of the demand for tuna. This information is detailed on pages 58 to 88.

Volume Changes Which Have Occurred or Are Expected to Occur in Packs of Canned Tuna

Consumption of canned tuna throughout the years has not held to a rigid pattern. When the industry began, albacore was the only species

Figure 4

COMPARISON OF FOREIGN SUPPLY OF CANNED TUNA AND TUNALIKE FISHES TO FOREIGN SUPPLY OF ALL CANNED FISH, 1930-1951.



1/ Data from table 6.

2/ Data from table 5.

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used. Today it is only a small part of the total pack. There have been changes too in the use of different sized cans by tuna packers. Consumers' desires dictate what tuna packers shall produce and are far from uniform. The whole subject of consumption is a dynamic one with changes continually taking place. The changes in the volume of the various types of products, species used, and can sizes are discussed in the following pages.

TYPE OF PACK SUCH AS SOLID, CHUNK, GRATED, FLAKES, ETC., AND ADDITIVES SUCH AS OIL AND BRINE

Since 1938, there has been a trend away from the type of packing known as solid pack. Prior to that time, over 90 percent of the production was solid pack. The only tuna packed as flakes was that which could not be packed as solid pack because of the small size of pieces. Between 1938 and 1946 an increasingly large amount of tuna was canned as grated tuna. Sales of the grated product increased so that more and more of the pack was put up in this manner. In 1948, the first pack of chunk style or bite-size tuna was marketed. This was an improvement on the grated pack and still retained the labor-saving advantages. As a result of these changes only 35 percent of the 1952 production was solid pack. Figure 5 shows the percentage of the total pack that was canned as solid pack during the years 1929-1952. Table 7 shows the production broken down into solid pack and "other" for that period.

Practically all of the pack during this period was in oil. Since 1950, a small quantity of dietetic pack (in distilled water without salt) and of strained tuna for baby food has been packed. As the amount packed was relatively insignificant, it has been included with other tuna in the statistical data. Some tuna and noodles were packed in 1952, but data on this pack have not been included in the tables on canned fish production in this report.

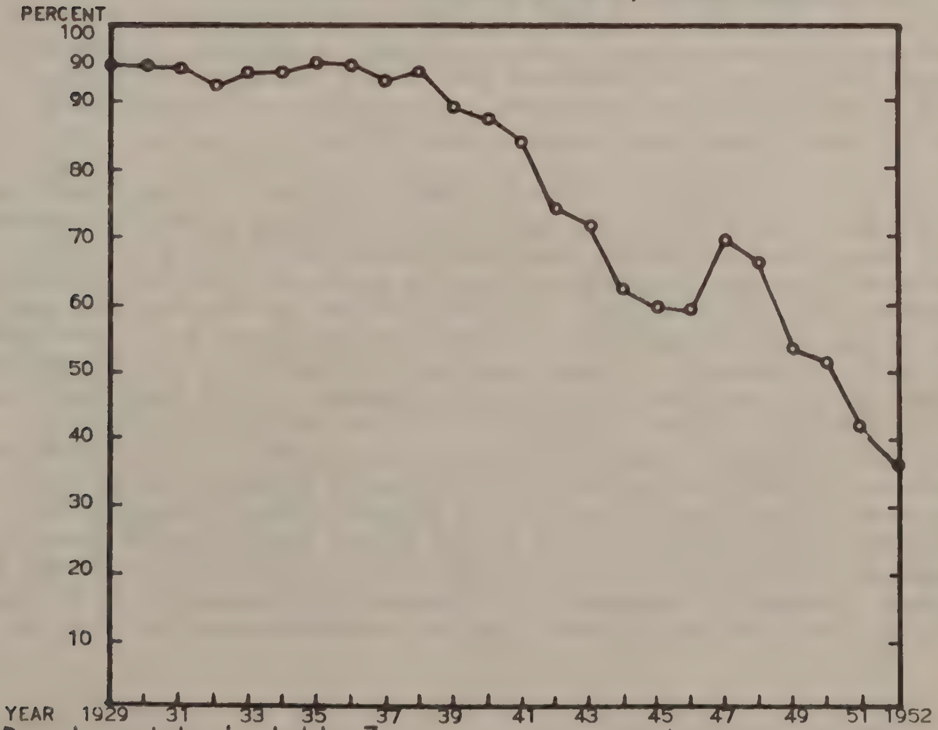
Several factors are considered by consumers in the buying of solid, or chunk; or grated tuna. Price differentials and the use of the product are the primary considerations. The usual price premium that many consumers are willing to pay for solid pack is attributed to a better appearance and a belief as to its better quality. Since the introduction of the chunk style pack several years ago, however, there has been a shift to this pack by consumers in many markets. The solid pack must be broken up for use in salads or cooked dishes, but the chunk pack, while still retaining a good appearance, is in more convenient form for use and sells at a lower price per can and usually per ounce of contents.

Table 7. - PACK OF TUNA AND TUNALIKE FISHES: BY TYPE OF PACK, 1929 - 1952

YEAR	SOLID PACK		OTHER		TOTAL
	POUNDS	PERCENT	POUNDS	PERCENT	POUNDS
1929.	29,462,580	94.2	1,823,868	5.8	31,286,448
1930.	39,523,512	94.5	2,314,224	5.5	41,837,736
1931.	23,727,249	93.8	1,567,926	6.2	25,295,175
1932.	22,829,604	91.4	2,142,954	8.6	24,972,558
1933.	28,000,392	93.4	1,976,058	6.6	29,976,450
1934.	38,089,779	93.3	2,756,592	6.7	40,846,371
1935.	48,983,361	93.9	3,209,166	6.1	52,192,527
1936.	52,514,238	94.2	3,241,008	5.8	55,755,246
1937.	60,298,791	92.5	4,916,340	7.5	65,215,131
1938.	53,062,611	92.8	4,092,336	7.2	57,154,947
1939.	65,900,877	87.9	9,086,652	12.1	74,987,529
1940.	73,507,497	85.6	12,385,854	14.4	85,893,351
1941.	49,779,618	83,1	10,100,214	16.9	59,879,832
1942.	36,280,293	72.7	13,628,088	27.3	49,908,381
1943.	37,491,363	69.6	16,393,860	30.4	53,885,223
1944.	42,734,097	60.9	27,451,134	39.1	70,185,231
1945.	51,872,058	58.3	37,106,406	41.7	88,978,464
1946.	54,370,113	57.9	39,517,758	42.1	93,887,871
1947.	79,574,586	67.7	37,894,122	32.3	117,468,708
1948.	91,016,163	65.2	48,665,790	34.8	139,681,953
1949.	73,323,831	51.7	68,376,762	48.3	141,700,593
1950.	87,476,886	50.0	87,317,550	50.0	174,794,436
1951.	63,457,884	40.3	93,868,578	59.7	157,326,462
1952.	63,066,717	35.2	116,349,876	64.8	179,416,593

Figure 5

PERCENTAGE OF TUNA AND TUNALIKE FISHES CANNED AS SOLID PACK, 1929-1952



Based on data in table 7.

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Most members of the tuna canning industry anticipate a further considerable expansion in production of the chunk pack with a corresponding decrease in the solid pack. The chunk pack can be put up at a lower cost than the solid pack and most consumers, realizing that the solid pack is practically always broken up before the tuna is used, are readily accepting the chunk style with its usual lower price.

Of all the packers visited only one had ever put up a brine pack. This was an extremely small producer who believed the saving in oil was a worthwhile one. All others felt that, especially with the present low cost of oil, the small extra expense for oil was well worthwhile and they had no plans for future marketing of a brine pack.

All tuna canners contacted used soya oil exclusively (except for the special tonno pack in which olive oil was employed). They had, in the past, used cottonseed and peanut oil. During World War II, scarcity of these oils led them to use the then-more-plentiful soya oil. Since labels have to declare the type of oil used, the industry has standardized on soya. They have no particular preference for it other than its availability and low cost. Should future shortages develop the type of oil might change; otherwise the industry will probably continue to use soya oil.

Flake and grated style packs attract consumers who stress their lower price. The finely chopped appearance of these packs deter many consumers from buying them, in spite of their usefulness in dishes which require cut-up tuna. If consumers were better informed as to the quality, convenience and inexpensiveness of flake and grated packs, the sales of these packs could be further expanded.

While it is generally agreed in the trade that a price incentive is necessary in order to sell tuna packed in brine, it is also agreed that a market has definitely been established for it among household consumers. However, a market for tuna in brine has not been established throughout the United States. Its distribution has been spotty, but where it has been introduced, it appears to have taken hold. According to a study conducted by a local newspaper in Seattle, a certain brand of tuna in brine was third in quantity of sales for all tuna products sold in the Seattle area during 1952. It was outsold only by two nationally-advertised domestic tuna in oil brands. Tuna in brine has established itself on the retail level also in Minneapolis, in most west coast cities, and in many of the eastern cities, except in New York City. How well established it has become appears to be directly correlated to the efforts of the large retail grocery chains to add it to their lines and to promote it. Because of the necessity to be competitive, when one chain grocery begins to purchase and sell tuna in brine the others follow readily. Brokers and wholesalers report that there is a slow but steady increase in orders for tuna in brine in No. ½ or "shelf" size containers. They report that homemakers are gradually becoming accustomed to the use of tuna packed in brine.

In connection with its preparation for a hearing on proposals to adopt standards for canned tuna, the Food and Drug Administration made a survey of household consumers in the last quarter of 1952. Certain questions were asked about brine and oil packs. A total of 4,119 replies to the following questions were tabulated with results as shown:

1. Have you purchased canned tuna packed in water (with or without salt)?

   Yes - 513   No - 2,661   Don't remember - 651   Not answered - 294

2. If you have bought canned tuna packed in water, did the label on the can describe it so that before you opened the can you knew it was packed in water?

   Yes - 458   No - 187   Not answered - 3,474

3. When you use canned tuna packed in oil, do you use the oil?

   Yes, always - 1,097   Yes, sometimes - 1,161   No - 1,718   Not answered - 143

4. If you use the oil (either always or sometimes) how do you use it? Replies to this question indicated three general uses:

   1. Oil is not separated from the fish.

   2. Oil is separated and part added to tuna salad.

   3. Oil is used in what was often referred to as creamed tuna.

5. Considering the ways in which you use canned tuna, would you prefer:

About the proportion of oil you now get.....	1,544
More oil and less fish......................	20
More fish and less oil......................	2,304
Not answered................................	251

Tuna and bonito packed in brine have to a great extent replaced oil packs in institutional markets. These packs are made by foreign firms who now supply the greater part of the United States institutional consumers' needs. Hotels, restaurants, school lunchrooms, hospitals, and other quantity food purveyors in all areas canvassed have shown an overwhelming change to brine packs. In the New England area the following reasons are given for this change:

1. It is usually a solid pack which is entirely usable and has customer appeal and acceptance.
2. It is more economical when compared to the oil pack.
3. The large size can -- such as the No. 4 -- has advantages in that it cuts costs by saving time and labor in preparation, and requiring less handling and storage space.
4. It is a quality pack.
5. It keeps well in storage.
6. Packing in brine does not necessarily detract from appearance, texture, or flavor.
7. When drained, it is adaptable for all culinary purposes.

One of the largest wholesale grocers in the United States, catering primarily to institutional users, reports doing about 85 percent of his tuna business with the imported brine packs. In fact, the domestic oil packs now make up only about one-half of one percent of his sales. Before the brine packs became available, this wholesaler was selling a fairly large volume of domestic packs of tuna in oil. Many wholesalers and brokers report that although they do not carry any brine packs in the retail or "shelf" size containers, they do carry brine packs in the larger volume containers that are used by institutions.

Institutions and restaurants purchase foods on a more objective basis than household consumers. Since tuna in brine can be bought for less, and is substitutable for tuna in oil, it is not surprising that the brine pack has found wide acceptance by this trade. The brine pack is particularly suitable for cooked tuna dishes where the oil is not necessary. If household consumers made purchases in accordance with requirements of the dishes they prepared the increase in brine pack sales no doubt would be considerable. However, there is nothing to indicate this will occur in the near future. Consumption of the brine pack is expected to be limited for some time to come.

SPECIES SUCH AS ALBACORE, BLUEFIN, SKIPJACK, YELLOWFIN, BONITO, ETC.

During the period 1929-1952, there was no definite trend toward acking a particular species. Figure 6 shows the percentage of the otal pack that was packed from yellowfin, albacore, and skipjack. The bsence of most of the clipper fleet during the war years accounts for he lower percentage of yellowfin and skipjack during that period. The data for 1944 are not comparable with the other years, as all of the flake and grated light-meat pack was listed as mixed tuna rather than being credited to the various species.

Table 8 includes revised data on the poundage of each species of tuna canned from 1929-1952. These data were obtained by multiplying the number of standard cases of solid pack by 21 and of flakes and grated by 18. In this table the chunk-style pack has been included with flakes and grated and converted to pounds by multiplying by 18, except in 1952 when the factor was changed to 19.5. As separate data were not available on this style of pack prior to 1952, it was not possible to use this factor on the earlier data.

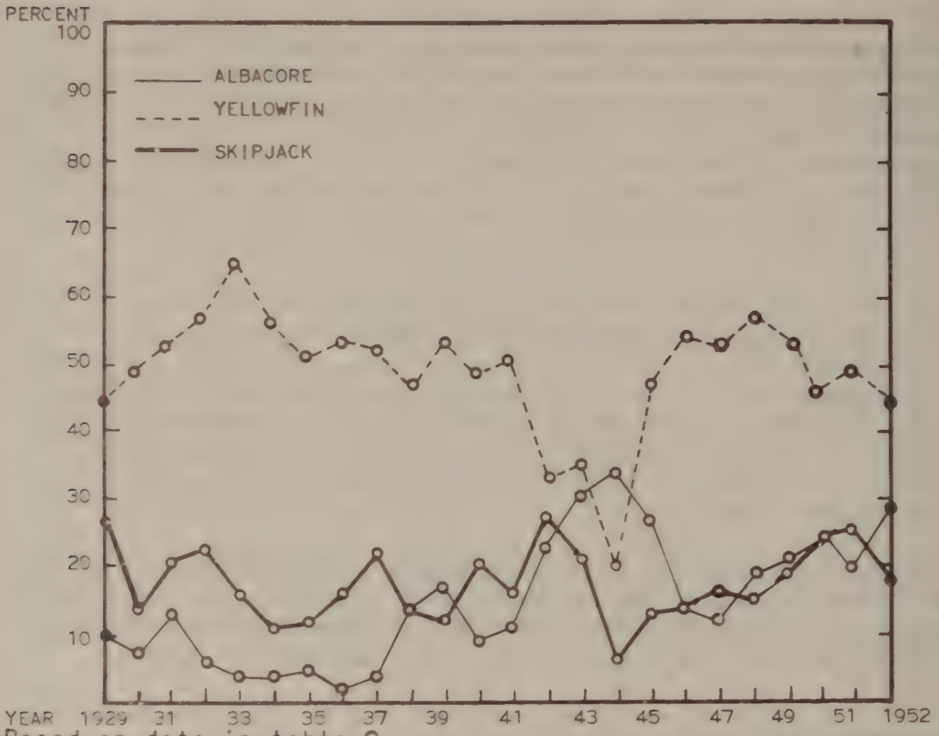
For all practical purposes from the consumer point of view, there are only two varieties of canned tuna — white meat (albacore) and light meat (skipjack, yellowfin, bluefin, and little tuna). The dark meat of any species is less salable than the white meat or light meat in American markets.

The white meat of canned albacore commands a premium on most domestic markets, particularly in cities such as New York and Boston. Albacore also is popular with canners because of the high yield and the uniformity of size which makes for easier handling in the plant. Thus, even when the white meat market is saturated, canners can usually pack albacore profitably as a light-meat product. The higher price of albacore as a raw material may be more than offset by the greater canning yield.

The more erratic supply causes a greater fluctuation in albacore prices than in those for light-meat tunas. Table 9 and figure 7 show the annual average prices paid to west coast fishermen for albacore, yellowfin and yellowtail from 1929 through 1952 with early 1953 prices. Prices of all species as shown in figure 7 tend to move together, with albacore having wider movements. In 1951 large imports of albacore

Figure 6

PERCENTAGE OF TOTAL PRODUCTION OF CANNED TUNA AND TUNALIKE FISHES PACKED FROM CERTAIN SPECIES, 1929-1952



Based on data in table 8.

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dropped the price of domestic albacore close to yellowfin. At times during the year prices were reported for domestic albacore which were lower than reported prices for yellowfin.

As may be determined from table 8 the pack of light-meat tuna represents by far the greater percentage of the total pack of tuna. The principal reasons for the larger sales of light-meat tuna are its greater abundance and lower cost as compared to white-meat tuna. The supply of albacore is limited as compared to the several light-meat species where, if one species is scarce,

Table 8. - CANNED PACK OF TUNA AND TUNALIKE FISHES, 1929 - 1952

EAR	ALBACORE			YELLOWFIN		
	SOLID	FLAKES AND GRATED	TOTAL	SOLID	FLAKES AND GRATED	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1929	2,977,107	121,122	3,098,229	12,600,630	1,105,146	13,705,776
1930	2,969,421	54,576	3,023,997	18,492,222	1,785,942	20,278,164
1931	3,062,178	213,120	3,275,298	12,491,892	1,020,078	13,511,970
1932	1,387,323	129,978	1,517,301	12,424,314	1,687,734	14,112,048
1933	1,061,319	64,044	1,125,363	17,611,230	1,758,042	19,369,272
1934	1,723,533	153,468	1,877,001	20,493,501	2,248,038	22,741,539
1935	2,356,494	180,144	2,536,638	24,454,710	2,322,720	26,777,430
1936	1,203,573	104,526	1,308,099	27,049,680	2,684,808	29,734,488
1937	2,072,868	283,554	2,356,422	30,213,162	3,798,972	34,012,134
1938	7,008,183	908,316	7,916,499	24,382,995	2,610,666	26,993,661
1939	10,327,590	2,338,272	12,665,862	33,393,654	6,271,740	39,665,394
1940	6,436,731	1,392,426	7,829,157	34,070,274	8,447,652	42,517,926
1941	5,613,573	728,550	6,342,123	23,739,975	7,103,466	30,843,441
1942	9,726,885	1,746,378	11,473,263	10,383,534	6,123,564	16,507,098
1943	13,112,211	3,403,476	16,515,687	13,015,926	5,966,568	18,982,494
1944	18,039,966	5,953,248	23,993,214	14,166,411	-	14,166,411
1945	17,375,610	6,979,860	24,355,470	25,119,675	16,465,266	41,584,941
1946	9,567,075	3,647,448	13,214,523	31,850,343	18,577,764	50,428,107
1947	11,011,056	3,450,474	14,461,530	40,498,143	22,206,456	62,704,599
1948	19,814,424	6,402,582	26,217,006	47,860,197	31,300,128	79,160,325
1949	22,540,749	7,082,640	29,623,389	33,885,117	41,205,348	75,090,465
1950	32,357,262	9,234,360	41,591,622	35,992,215	45,565,758	81,557,973
1951	21,711,942	9,537,318	31,249,260	25,822,818	51,144,066	76,966,884
1952	28,284,921	3/ 23,485,034	51,769,955	22,532,034	3/ 55,934,802	78,466,836

YEAR	BLUEFIN			SKIPJACK		
	SOLID	FLAKES AND GRATED	TOTAL	SOLID	FLAKES AND GRATED	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1929	2,039,856	88,884	2,128,740	7,799,211	269,694	8,068,905
1930	6,432,237	398,196	6,830,433	5,460,924	73,206	5,534,130
1931	877,863	91,656	969,519	4,735,101	216,774	4,951,875
1932	156,807	38,052	194,859	5,171,775	287,010	5,458,785
1933	77,679	8,640	86,319	4,565,127	145,332	4,710,459
1934	6,296,409	222,642	6,519,051	4,599,021	132,444	4,731,465
1935	7,878,066	618,984	8,497,050	5,906,586	87,318	5,993,904
1936	6,167,028	366,318	6,533,346	8,906,226	85,356	8,991,582
1937	4,052,181	437,220	4,489,401	14,132,454	396,594	14,529,048
1938	6,596,625	346,482	6,943,107	7,048,650	226,872	7,275,522
1939	4,326,966	267,210	4,594,176	8,487,402	209,430	8,696,832
1940	5,784,702	885,636	6,670,338	15,389,115	1,515,654	16,904,769
1941	3,176,838	350,208	3,527,046	8,421,063	993,438	9,414,501
1942	4,605,468	1,217,502	5,822,970	8,810,256	4,470,372	13,280,628
1943	3,182,529	1,169,136	4,351,665	6,004,068	5,314,122	11,318,190
1944	5,080,425	-	5,080,425	4,231,689	-	4,231,689
1945	4,170,096	4,546,314	8,716,410	3,350,886	8,275,662	11,626,548
1946	5,264,280	4,437,486	9,701,766	5,668,656	7,857,810	13,526,466
1947	6,365,604	2,605,122	8,970,726	13,775,622	5,637,582	19,413,204
1948	1,830,255	1,109,214	2,939,469	13,539,267	7,302,798	20,842,065
1949	762,951	729,828	1,492,779	10,667,433	16,758,270	27,425,703
1950	245,028	714,996	960,024	13,267,800	29,349,918	42,617,718
1951	421,407	933,390	1,354,797	9,863,742	29,827,764	39,691,506
1952	528,066	3/ 1,331,284	1,859,350	5,136,096	3/ 26,837,757	31,973,853

SEE FOOTNOTES AT END OF TABLE.

(CONTINUED ON NEXT PAGE)

Table 8. - CANNED PACK OF TUNA AND TUNALIKE FISHES, 1929 - 1952 - Continue

YEAR	MISCELLANEOUS OR MIXED			"TONNO"	BONITO	
	SOLID	FLAKES AND GRATED	TOTAL	SOLID	SOLID	FLAKES AND GRATED
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1929	348,012	239,022	587,034	2,480,625	730,569	-
1930	-	-	-	3,351,096	1,871,499	2,304
1931	-	-	-	1,400,427	1,091,349	25,614
1932	-	-	-	2,561,853	1,039,185	180
1933	-	-	-	2,871,540	891,219	-
1934	-	-	-	3,517,164	1,219,743	-
1935	-	-	-	3,377,808	3,034,416	-
1936	-	-	-	3,618,846	2,753,877	-
1937	-	-	-	5,309,997	3,195,675	-
1938	-	-	-	2,948,400	3,317,559	-
1939	-	-	-	4,621,039	4,089,099	-
1940	-	-	-	7,921,452	2,250,738	28,728
1941	-	-	-	2,038,974	4,670,421	22,950
1942	-	-	-	1,159,473	658,518	55,602
1943	-	-	-	(1)	945,840	87,894
1944	-	21,057,588	21,057,588	603,603	173,859	40,842
1945	-	-	-	956,235	754,803	322,290
1946	-	3,347,082	3,347,082	(2)	1,757,238	522,180
1947	28,182	1,457,622	1,485,804	1,469,895	4,446,036	886,086
1948	564,312	561,024	1,125,336	1,872,507	3,177,867	612,648
1949	678,363	792,558	1,470,921	3,541,482	455,658	216,648
1950	218,904	1,379,430	1,598,334	5,136,810	27,279	209,736
1951	1,826,076	903,996	2,730,072	3,373,146	188,706	98,694
1952	2,297,694	[3] 5,592,752	7,890,446	3,077,907	341,607	557,028

YEAR	BONITO-CONTINUED	YELLOWTAIL		
	TOTAL	SOLID	FLAKES AND GRATED	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS
1929	730,569	486,570	-	486,570
1930	1,873,803	946,113	-	946,113
1931	1,116,963	68,439	684	69,123
1932	1,039,365	88,347	-	88,347
1933	891,219	922,278	-	922,278
1934	1,219,743	240,408	-	240,408
1935	3,034,416	1,975,281	-	1,975,281
1936	2,753,877	2,815,008	-	2,815,008
1937	3,195,675	1,322,454	-	1,322,454
1938	3,317,559	1,760,199	-	1,760,199
1939	4,089,099	655,137	-	655,137
1940	2,279,466	1,654,485	115,758	1,770,243
1941	4,693,371	2,118,774	901,602	3,020,376
1942	714,120	936,159	14,670	950,829
1943	1,033,734	1,230,789	452,664	1,683,453
1944	214,701	438,144	399,456	837,600
1945	1,077,093	144,753	517,014	661,767
1946	2,279,418	262,521	1,127,988	1,390,509
1947	5,332,122	1,980,048	1,650,780	3,630,828
1948	3,790,515	2,357,334	1,377,396	3,734,730
1949	672,306	792,078	1,591,470	2,383,548
1950	237,015	231,588	863,352	1,094,940
1951	287,400	250,047	1,423,350	1,673,397
1952	898,635	804,573	[3] 2,562,493	3,367,066

SEE FOOTNOTES AT END OF TABLE.

(CONTINUED ON NEXT PAGE)

ble 8. - CANNED PACK OF TUNA AND TUNALIKE FISHES, 1929 - 1952 - Continued

YEAR	GRAND TOTAL		
	SOLID	FLAKES AND GRATED	TOTAL
	POUNDS	POUNDS	POUNDS
1929	29,462,580	1,823,868	31,286,448
1930	39,523,512	2,314,224	41,837,736
1931	23,727,249	1,567,926	25,295,175
1932	22,829,604	2,142,954	24,972,558
1933	28,000,392	1,976,058	29,976,450
1934	38,089,779	2,756,592	40,846,371
1935	48,983,361	3,209,166	52,192,527
1936	52,514,238	3,241,008	55,755,246
1937	60,298,791	4,916,340	65,215,131
1938	53,062,611	4,092,336	57,154,947
1939	65,900,877	9,086,652	74,987,529
1940	73,507,497	12,385,854	85,893,351
1941	49,779,618	10,100,214	59,879,832
1942	36,280,293	13,628,088	49,908,381
1943	37,491,363	16,393,860	53,885,223
1944	42,734,097	27,451,134	70,185,231
1945	51,872,058	37,106,406	88,978,464
1946	54,370,113	39,517,758	93,887,871
1937	79,574,586	37,894,122	117,468,708
1948	91,016,163	48,665,790	139,681,953
1949	73,323,831	68,376,762	141,700,593
1950	87,476,886	87,317,550	174,794,436
1951	63,457,884	93,868,578	157,326,462
1952	63,002,898	3/116,301,150	179,304,048

1/ THE SOLID PACK OF "TONNO" HAS BEEN INCLUDED WITH THE PACK OF BONITO.
2/ THE SOLID PACK OF "TONNO" HAS BEEN INCLUDED WITH THE PACK OF MISCELLANEOUS OR MIXED.
3/ CHUNK STYLE WAS CONVERTED FROM STANDARD CASES TO POUNDS IN 1952 BY MULTIPLYING BY 19.5.

NOTE:--DATA FOR 1952 INCLUDES PACK IN HAWII. CHUNK STYLE PACK HAS BEEN INCLUDED WITH FLAKES AND GRATED.

a more abundant one usually can be used. In production of light-meat canned tuna, canners have a marked preference for yellowfin over skipjack. Skipjack, being of very small size, not only results in a lower yield than yellowfin but also involves much higher cleaning costs. The large spread in production costs between the two species was not fully appreciated until recent careful cost studies were completed. It is reported that some processors found that they were losing money on all skipjack canned. The price paid to fishermen for skipjack has always been lower than that paid for yellowfin. Under the 1953 contracts, however, yellowfin continues to bring $320 per ton while the skipjack price was raised from $260 to $280 per ton.

Table 9. - AVERAGE ANNUAL EX-VESSEL PRICES FOR ALBACORE, YELLOWFIN, AND YELLOWTAIL, WEST COAST, 1929 - 1953

YEAR	SPECIES		
	ALBACORE	YELLOWFIN	YELLOWTAIL
	CENTS PER POUND	CENTS PER POUND	CENTS PER POUND
1929	14.87	5.88	4.88
1930	8.39	5.99	4.40
1931	8.11	5.41	3.33
1932	5.00	4.08	2.84
1933	(1)	4.45	2.26
1934	7.44	5.01	3.37
1935	8.17	5.01	2.87
1936	9.25	5.28	2.96
1937	8.15	5.96	3.95
1938	5.45	6.01	1.60
1939	5.33	5.35	3.35
1940	6.87	5.90	3.41
1941	14.35	6.32	3.90
1942	19.40	9.25	7.08
1943	16.27	9.91	7.48
1944	16.41	9.92	7.92
1945	19.49	9.97	8.26
1946	19.82	11.48	8.20
1947	25.26	15.58	11.29
1948	29.63	16.75	11.13
1949	18.32	16.27	9.37
1950	19.11	15.34	8.90
1951 [2]	15.74	15.46	9.49
1952 [3]	18.60	16.00	9.25
1953 [3]	(1)	16.00	9.25

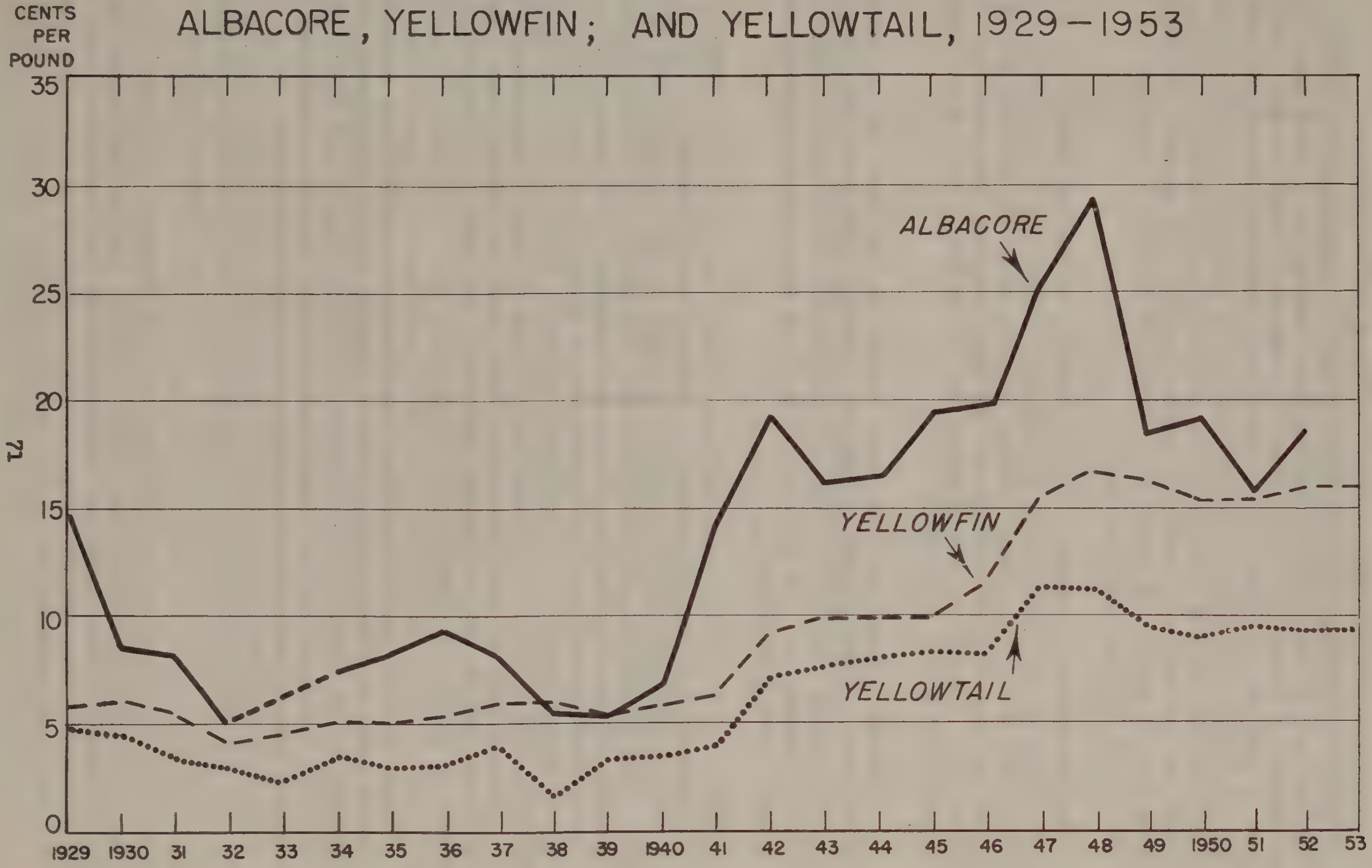
[1] NOT AVAILABLE.
[2] WEIGHTED AVERAGE OF CALIFORNIA LANDINGS.
[3] BASED ON REPORTED CONTRACT PRICES FOR 1952 AND FIRST THREE MONTHS OF 1953.

With this differential the fishermen still may be expected to fish preferentially for yellowfin rather than skipjack. During periods of scarcity of fish, however, fishermen hesitate to pass up a good run of skipjack on the chance of later finding yellowfin. Under present conditions it is not believed that the new price differential will cause much change in the ratio of landings of these two species. Bluefin landings are not expected to change in volume except in accordance with normal fluctuations in abundance.

Bonito and yellowtail, the tunalike fishes, will probably not be caught and packed in significantly increased quantities by the domestic industry unless there is an increase in the present domestic tariff on importations of these products. The market for these species will probably continue to be supplied predominatly by foreign packers. Even if a tariff increase should occur, expansion of the catching and processing of these species by the domestic industry would be limited since the demand for them is relatively weak compared to the species which can be canned and sold as tuna.

Figure 7

WEST COAST AVERAGE EX-VESSEL PRICE FOR TWO SPECIES OF TUNA, ALBACORE, YELLOWFIN; AND YELLOWTAIL, 1929–1953



Data from table 9.

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CAN SIZES

During the period 1935-1952, there was a significant increase in the proportion of the pack of canned tuna in the No. ½ tuna can. These cans contain 7 ounces of solid pack, 6½ ounces of chunk style, or 6 ounces of grated or flake style. These weights are net weights and include the weight of fish, oil, and salt. In figure 8 it will be noted that 76 percent of the pack in 1935 was in this size can. In 1946, this had increased to 99 percent, while in 1952, 95 percent of the production was in the No. ½ tuna can. Table 10 lists the quantity of tuna packed in the various can sizes.

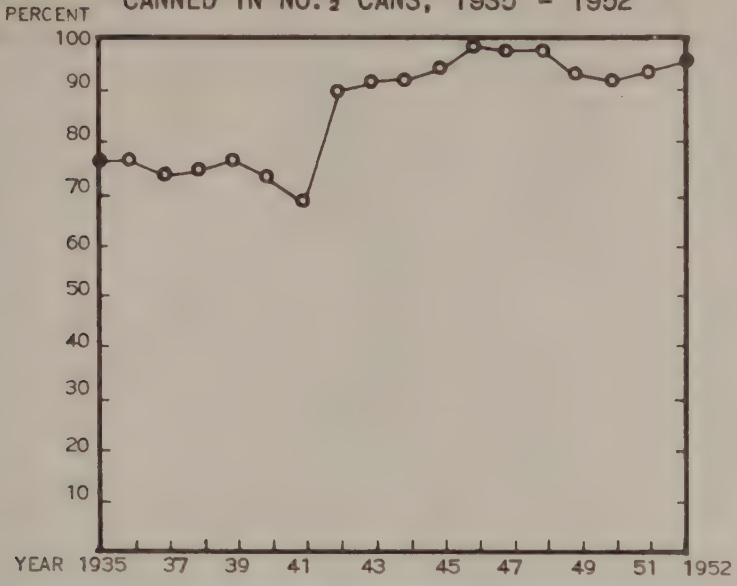
The percentage increase in the quantity packed in the No. ½ tuna can was largely at the expense of the No. 1 tuna can or the size known in the trade as "1's", except during the war when the smaller No. ¼ tuna can was not packed because of the tin conservation program. From 1949 to 1952, a small pack was again put up in No. 4 tuna cans, which is the institutional size pack.

To convert a canning line from the use of one size can to another involves substantial expense. The tuna canning industry fortunately has a sufficient variety of sizes on the market at present to meet the demand of consumers. The popular flat No. ½ tuna can adequately meets the needs of most families.

The No. 1 can which contains about twice the contents of the No. ½ can is currently being emphasized in several retail markets. It is too soon to know how well this size will go, but it is expected that the market will be limited, especially since the saving to consumers over the buying of the smaller No. ½ tuna can appears to be negligible. If the larger can were priced so as to show a significant saving to the consumer, it might develop a significant volume. However, the general trend in urban markets is toward smaller can sizes. Rural markets buy most foods in larger quantities, but need first to become tuna conscious before they can be sold a larger size can. Now the No. ½ can would be the reasonable one to promote in rural markets.

It certainly appears that the industry has a sufficient variety of different size cans to satisfy present demand, and to experiment with additional sizes would be questionable. Of course, as the industry processes tuna mixed with other foods, such as noodles, etc., the size and type of container may have to undergo considerable change.

Figure 8
PERCENTAGE OF TUNA AND TUNALIKE FISHES CANNED IN NO. ½ CANS, 1935 - 1952



Based on data in table 10

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A possible small change in can size might result from the pending Food and Drug Administration standards for canned tuna. These standards are expected to call for a fill-in weight of 6.0 ounces of tuna for the solid pack and 5.75 ounces for the other packs. This is greater than the present fill-in weights used in the industry. One possibility of avoiding an increase in the price per can which would result from such a standard is a reduction in the height of the can by such an amount that the fill-in weight would not have to be changed. This could be done without increasing the cost per can to the consumer as he would get just as much fish as formerly. One drawback to such a change is that it is believed that foreign importations would still employ the standard No. ½ tuna can since it would not require any significant change in present packing procedure of foreign processors to comply with the proposed standards. This would place the domestic pack at a disadvantage. If foreign and domestic cans of tuna were adjacent to each other on the grocer's shelf, at the same price, consumers would tend to choose the slightly larger can. Present thinking in the tuna industry is reported to be against adoption of the slightly smaller can when and if the standards go into effect.

The tuna canning industry does not anticipate any marked change in the can sizes used in the future. The large institutional size cans are said to be less popular than might be anticipated because the production costs are very little less per pound of finished product than smaller sizes. In fact, some processors claim that it costs as much or more, proportionally, to pack the No. 4 tuna can as the No. ½ can.

Table 10. - PACK OF TUNA AND TUNALIKE FISHES BY CAN SIZE, 1935 - 1952

YEAR	NO. 1/4 (48)	NO. 1/4 (100)	NO. 1/2 (48)	NO. 1/2 (96)	NO. 1 (48)
	ACTUAL CASES	ACTUAL CASES	ACTUAL CASES	ACTUAL CASES	ACTUAL CASES
1935	205,295	149,098	1,915,459	-	168,710
1936	207,577	159,198	2,040,049	-	185,538
1937	252,882	223,353	2,293,454	-	245,981
1938	282,178	123,682	2,048,434	-	215,374
1939	298,463	188,438	2,784,835	-	253,629
1940	373,977	331,952	3,068,839	-	284,759
1941	266.767	96,917	2,036,782	-	324,776
1942	195,708	50,263	2,228,862	-	64,975
1943	51,464	-	2,490,203	-	103,409
1944	46,669	-	2,650,145	330,427	120,634
1945	-	-	4,342,495	-	100,691
1946	-	-	4,737,788	-	20,117
1947	-	-	5,789,969	-	50,213
1948	-	-	6,891,649	-	72,717
1949	316,733	(1)	6,863,959	-	88,891
1950	578,879	46,676	8,427,932	-	67,048
1951	471,444	57,324	7,720,604	-	73,523
1952	600,088	70,699	8,627,722	-	32,053

YEAR	NO. 4 (6)	NO. 4 (12)	MISC. (48)	TOTAL	TOTAL
	ACTUAL CASES	ACTUAL CASES	ACTUAL CASES	ACTUAL CASES	STANDARD CASES
1935	-	-	-	2,438,562	2,510,828
1936	-	-	-	2,592,362	2,680,734
1937	-	-	-	3,015,670	3,144,501
1938	-	2,522	-	2,672,190	2,754,143
1939	-	2,674	-	3,528,039	3,642,951
1940	-	8,665	-	4,068,192	4,188,460
1941	-	5,454	-	2,730,696	2,931,581
1942	-	-	-	2,539,808	2,484,749
1943	-	-	-	2,645,076	2,696,073
1944	-	-	-	3,147,875	3,560,020
1945	-	-	-	4,443,186	4,531,565
1946	-	-	6,346	4,764,251	4,784,484
1947	-	-	4,100	5,844,282	5,894,495
1948	-	-	614	6,964,980	7,037,758
1949	10,190	-	1/63,906	7,343,689	7,290,320
1950	-	31,115	621	9,152,271	9,016,541
1951	-	25,383	74	8,348,352	8,236,725
1952	-	8,102	19,278	9,357,942	9,115,202

1/ THE PACK OF 1/4 POUND CANS (100 TO THE CASE) HAS BEEN INCLUDED WITH MISCELLANEOUS SIZES.

NOTE:--DATA FOR 1952 INCLUDES PACK IN HAWAII.

Most processors do not anticipate any marked demand for the No. ¼ tuna can. A few processors, especially those selling their fish in specialty markets such as New York City, indicate that there is some increase in demand for a No. ¼ tuna can for use by small families such as apartment house dwellers.

It is believed that the No. ½ tuna can represents about the best approximation of the needs of average consumers.

Acceptability of East Coast Packs by Consumers

Of the total pack of over 9,115,202 standard cases of tuna produced in the United States and Hawaii in 1952, slightly over 200,000 cases or about two percent was packed on the Atlantic Coast. Obviously such a small volume could not be distributed very widely. As a result very little is known regarding the acceptability of the east coast packs compared with those of the west coast. The Atlantic Coast pack consisted of bluefin and little tuna from the east coast and yellowfin and skipjack and albacore from other areas.

Comments from the New England Area indicate that the east coast pack of albacore is quite acceptable. One of thelargest chain grocers in the southern and southeastern states reports very good sales of the east coast pack of yellowfin tuna but reported the lack of a regular supply. The packs of Atlantic coast species, such as bluefin and little tuna, are not considered quite as acceptable as the light-meat packs produced from either imported tuna or from the west coast yellowfin and skipjack because of the darker appearance and, in some cases, a somewhat stronger flavor. However, the latter factor is considered an attribute by some small segments of the United States population. In general, however, the prevailing American consumer preference is for the milder flavored product. Those selling the east coast product report that consumers know very little about this pack.

As the east coast pack increases in volume and becomes more widely distributed there is every reason to believe that its use and acceptability will expand. It is not expected that the geographical point of packing will be of any significance in influencing the consumers' choice of canned tuna packs insofar as quality of comparable species is concerned.

Acceptability of Bonito and Tuna by Consumers [4]

Most distributors agree that canned bonito is an acceptable product and that there is a definite place for it on the market, primarily as a lower priced item. At the retail level, chain stores are doing a reasonably good business with bonito. These retailers reported average volume sales of canned bonito as approximately one-third those of their sales of canned tuna. Several chain store operators indicated increased sales of canned bonito over the past two years and attributed this largely to the lower cost as compared with canned tuna. Aside from price, bonito is preferred by some household consumers in certain areas of the country or because of racial or religious backgrounds. It is reported, for instance, that Italian-American and other Americans of southern European origin show a preference for bonito. Similarly, bonito is reported to be more available on grocers shelves in Pennsylvania than in Illinois.

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[4] In this section "canned tuna" does not include tunalike species.

Bonito sells best in the institutional trade. Almost without exception, bonito was found to be used widely by hotels, restaurants, and lunchrooms. Although the sales of tuna far exceed that of bonito, the trend of increased imports of bonito into the United States points to the fact that this species is being increasingly accepted on both the retail consumer and the quantity food purveyor levels. available In 1948, the first year for which canned bonito import figures are/ there was a total of 306,000 pounds of canned bonito and yellowtail (mostly bonito) imported into the United States. In 1949 and 1950 imports of these products rocketed to 8,099,000 and 8,135,000 pounds respectively. In 1952, imports of canned bonito and yellowtail (mostly bonito) reached a total of 13,812,000 pounds. Reduced to relative figures, the 1952 imports represent an increase of 70 percent over 1949 and an increase of 4400 percent over 1948.

Consumer Familiarity With the Various Styles of Canned Tuna Packs

In general, consumers appear to recognize quite clearly the different types and styles of packs of canned tuna. It is doubtful that they are generally aware of any standards with respect to original quality of fish or fill of container. Species identification on labels is not required by law or regulation except for bonito and yellowtail. Few packers identify the other species. At present, practically the only other species named on labels is albacore, which is marketed as white meat. At the present time it appears that consumers are generally aware only that they are buying white or light meat in either a solid pack or as chunk, flakes, or grated packs. The pack designations other than solid are used somewhat interchangeably — chunk and "bite size" are alike, and flakes or grated are similar.

With the exception of the Boston and New York City metropolitan areas, the predominant demand is for the chunk style packs. Retailers, wholesalers, and brokers in most of the United States report sales in the ratio of 3:2, 2:1, and 4:1 for chunk style over solid packs in the three best selling brands. In the Boston and New York City areas, notably high-priced markets, the ratio of sales by types of packs is reversed. Solid pack, white meat, is by far the best seller in the ratio of from 2:1 to as high as 9:1. In many instances, it is apparent that the solid packs are purchased for no other reason than that it is assumed the higher the price the better the product. There is, however, a slow but steady trend away from this type of consumer purchase.

Many consumers buy certain types of packs because of habit. Having once found a product to suit their tastes, they are reluctant to change. Often, however, there is no ready explanation for consumer preferences; or if there is one, the reason is lost in antiquity. This can best be illustrated by the public preference for brown shelled eggs in Boston and white shelled eggs in New York.

The Food and Drug Administration's consumer survey previously referred to, containing some information on this subject of consumers' familiarity with the various styles of canned tuna packs. Some of the questions asked and the replies of the 4119 responses tabulated were as follows:

1. In the last two years have you used canned tuna fish in your home?

   Yes - 4,004   No - 115

2. What forms of canned tuna have you bought?

   Solid pack — 2,953   Flakes ———— 1,521
   Grated ——— 1,472   Chunks ———— 2,373
   Other forms— 47   Mixed light and dark——— 650

3. Have you found any of the information on labels of canned tuna hard to understand?

   Yes - 205   No - 3,274

4. If you have found labels hard to understand, what statement on the label was not clear to you?

   Replies indicated that they were often confused about the meaning of the word "albacore."

Mr. Walter Richards (Richards, Walter, 1952), reports that of those interviewed in a recent survey conducted in southern California "three-fourths did not know the difference between packs by name . . . Those who always bought solid pack seemed to do so under the impression that it was very superior in quality. Not one housewife showed a knowledge of the use of pack with relation to recipe." This information is especially revealing when it is considered that in southern California, where most of the American tuna industry is located, the local populace would normally be expected to be better informed about this product.

All available data indicates a growing trend away from the solid pack to other styles of packs, particularly chunk style. This trend is reflected by the sales ratios previously quoted in this section. Many consumers undoubtedly turned to the chunk style pack when they found they could get a product which would serve most of their needs without having to pay the higher price per can for solid pack.

Some effort is now being made by the tuna industry and by consumer groups to educate the consumer with regard to styles of pack. A recent report made by a consumer's group rates 16 brands of canned tuna according to flavor, texture, color, etc., and also describes the grades and styles of pack, emphasizing the wisdom of purchasing according to the use intended.

Institutions, restaurants, and other quantity buyers prefer the solid packs. The domestic industry produced a No.4 tuna can pack from 1938 through 1941, and from 1949 to the present primarily in the solid style pack. However, the volume of the domestic pack in institutional size cans in 1951, the year of the largest volume, was only one percent of the entire pack of over 157 million pounds. Of an estimated 6,500,000 pounds of canned tuna (excluding tunalike) imports in 1951 in institutional size containers, 95 percent or more was solid pack. Of an estimated 2 million pounds of annual canned bonito imports in institutional size containers for the years 1951 and 1952, 100 percent was solid pack.

Consumer Demand For Tuna Products Other Than Canned

In an attempt to learn whether demand might be stimulated or markets created for tuna products other than canned tuna, inquiry was made among processors, distributors, and retailers of canned tuna. In addition, inquiry was also made of producers, processors and distributors of fresh, frozen, and cured fishery products.

These inquiries were limited to tuna, with tunalike products not being considered.

While many packers believe that the existing standard tuna pack is all that the housewife needs or wants, no large-scale attempt has ever been made to put up a mass produced tuna product consisting of tuna and some other food ingredient(s) which would be ready to serve by merely opening the can and heating. Several such products have been tried on a small scale in the past, but with the high cost of production (and associated high selling price) they have never been popular. One large tuna packer and another small processor are now in process of bringing out such a mass produced product. A few members of the tuna industry believe that such products may greatly expand the demand for tuna, but until the success or failure of this new venture can be determined, it is difficult to predict the future of such items.

The armed forces have expressed an interest in such products and, if they were to be made available in can size to fit the United States Army ration carton, there might be a considerable market for them.

Highly seasoned, smoked, and other specialty tuna products have been produced for many years in small volume but plant operators do not believe there is any possibility of greatly increasing their sale.

Palatability tests have been conducted in the Fish and Wildlife Service laboratories on some of the products mentioned above. All of the products were generally acceptable but some improvement was desirable. In the midwest some brokers and other distributors of canned tuna believe that tuna spreads could find markets in that area. A few distributors on the West Coast are moderately optimistic to enthusiastic over the possibilities of prepared products that the housewife needs only to heat and serve, such as tuna and noodles. Some hold that such products are the answer to a modern trend, that consumers are thus reached who might not otherwise be buyers of the conventional canned tuna.

Fresh and frozen tuna has been and is being sold in some areas. During a price dispute with canners in 1951, a California fishermen's union disposed of a volume of albacore in Los Angeles and San Francisco by direct sales to consumers. Of 1,400,000 pounds sold by the union, all but about ten percent were sold fresh. This ten percent was canned for the account of the union and sold mostly through its membership. The latter method of selling was reported to have met with little success. Most of the albacore sold fresh, through established retail channels, was used for home freezing or home canning. It is reported that the use for these two categories was about equally divided. To add impetus to this method of marketing, the fishermen's union prepared and distributed instructions for freezing, cooking, and canning the tuna.

During the 1952 season the fishermen's union made no attempt to sell albacore direct to the public, since the price offered by cannery operators was sufficiently attractive to discourage direct sales. There were isolated instances of attempts by individual fishermen to sell directly to the consumer in 1952 but withlittle or no success. However, during the 1951 season a great deal of publicity was given this subject through newspapers and radio and the public was sympathetic to the problems of the domestic tuna fishermen. It is not expected that direct sales to consumers in the manner described above will continue regularly but they might be attempted again if the unit remuneration to the fishermen from the canneries is markedly reduced. There is also a small market in Seattle for fresh and frozen tuna for home canning.

In the large city markets, such as Boston, New York City, Chicago and elsewhere, there is a constant market for a small volume of fresh and frozen tuna. Italian-Americans and others from southern European stock are the primary users of fresh and frozen tuna. The usual methods of preparation are frying, broiling, and baking. Fresh and frozen tuna is also used to some extent by Orientals in the United States.

There is some belief in California that frozen tuna would find a ready and wide market if packaged in consumer size packages in the form of frozen fillets and steaks. But this has not yet been tried on a large scale. There is some question whether such a product could compete successfully with fillets of bottom fish which are much lower priced. The tuna price structure is more comparable to that of salmon and halibut.

To say categorically that there is no possibility for the expansion of the tuna market through products other than canned tuna would be unduly pessimistic. It is difficult and perhaps unwise to attempt to predict what may happen in this field. As food industries

would not have altered the results to any degree.

Both of the domestic packers mentioned in connection with the study by the Seattle newspaper, make full use of every means of consumer education, including women's magazines, trade publications, newspapers, and radio and television as well as point-of-sale advertising.

Opinions differ widely among distributors as to the preference of the consumer with respect to name brands versus private labels. It is generally conceded, however, that the private label item is purchased primarily because of its lower price. (In most markets the price differential ranges from 2 to 4 cents per can lower for the private label for the same style pack.) The records of one of the larger chain stores showed that sales of nationally advertised brands exceeded those of their private brand in the ratio of 3:1 for chunk pack. This would seem to indicate a preference for the advertised brands, regardless of cost. One name brand alone achieved sales in the ratio of 4:5 against all other advertised brands combined.

A compilation of brand names of American packed tuna was made as of July 1952. This compilation revealed a total of 505 names, including some brand names which are used on one or more of the different types of packs in the tabulation below.

White	Fancy	Chunk	Grated	Tonno	Bonito	Other	Total
86	194	59	125	30	3	8	505

For the purpose of this tabulation the packs were identified as follows:

1. White - All packs identified as albacore, or white meat, except white meat chunks, grated or flakes.
2. Fancy - All light meat, including fancy solid, standard, etc., except light meat chunks, grated or flakes.
3. Chunk - All packs identified as chunk, chunklets, bite size, etc. regardless of type of meat.
4. Grated- All packs identified as grated, flakes, light and dark,etc. regardless of type of meat.

5. Tonno - All packs identified as tonno, regardless of type of meat.

6. Bonito

7. Other - All packs not covered by the above, such as dietetic, baby food, etc.

Institutional purchasers were found, as a rule, to be more conscious of price than of brand name. Although, here again, it is believed that once an institutional user has learned to depend on a particular brand, he will be reluctant to change to another unless he can be shown that he can save money and can get as good, or a better, product. As with all "rules" there are exceptions. Some chain drugstores and other quantity food purveyors are reported to use well known brands of tuna or other food products exclusively and advertise the item by brand name on their menus. This practice is usually based on a cooperative advertising effort between the processor and the user.

Stimulation of Consumer Demand by Promotional Activities And Market Development

With few exceptions, distributors maintain that the market for canned tuna in the United States has just begun to be tapped. More people are searching for lower-priced, high protein content foods, and fishery products of most kinds offer an excellent source. Present prices for canned tuna are attractive and within reach of the majority of the domestic population. On the whole, it is generally felt that the large processors of tuna in this country are doing a good job of promotion and that the present program of advertising is bound to result in an expanded market. Brokers and distributors of the primary name brands feel, on the other hand, that the remainder of the industry is capitalizing on the advertising efforts of the few and that it should expend some effort in the same direction. For this reason, they believe that industry-wide product promotion should be undertaken.

It is the opinion of some that the industry as a whole would profit by combining its efforts in the fields of product promotion and public relations. The meat industry was pointed up as an example of the success that might be achieved by such a program. One distributor suggested that the industry employ home economists to give demonstrations before women's groups, institutions, etc. to better acquaint the consumer with the versatility of canned tuna, the various types of pack, and the ways in which each may be used to prepare tasty and economical dishes. This would augment brand-name advertising.

Very few brokers felt that a cooperative promotion system would obliterate the identity of individual brand labels and destroy competition to put out a quality product. A happy medium of both product and brand promotion appears to be desired. Some distributors of the domestic canned product stated that a large-scale promotional program might have a serious drawback. They believed that consumers who would be educated to eat more tuna might well turn to the imported product as a matter of price, and the domestic packers would have gained nothing. This would be especially true of the institutions who use large quantities of tuna and who must buy at a low cost. In their opinion, any promotional program would have to emphasize domestic tuna and offer good incentives for buying it.

On the other hand, from the point of view of all firms participating in the United States canned tuna market, a cooperative product promotion program, without emphasis on any particular product or source, would appear to be desirable. The effort required to expand the domestic market for canned tuna on the basis of such a program could be made cooperatively by both domestic and foreign firms. A program along these lines is currently operated in the shrimp industry by an association composed of producers in Texas and Mexico.

A phase of product promotion that some feel could be exploited to a greater degree is that of recipe development. The bland and delicate flavor of tuna lends itself to preparation in an unlimited variety of ways and many believe that greater advantage can be taken of this inherent quality. Perhaps the most effective type of advertising, so far as the housewife is concerned, is an attractive, colorfully illustrated recipe. With this thought in mind, it has been urged that the industry include a recipe, preferably illustrated, with every advertisement and on every can label.

In general, it is believed by the trade that quantity food purveyors use far too little fishery products in their menus. The Fish and Wildlife Service has been conducting fish cookery demonstrations, especially in connection with the National School Lunch Program. One of the recipes used in this program utilizes canned tuna. It has been demonstrated conclusively by these demonstrations that canned tuna consumption can be increased several fold.

Present consumption of canned tuna and tunalike fishes in the United States is slightly over 11 million standard cases annually. On the basis of statistical analyses made in this survey and detailed on pages 89 to 98, it is estimated that in 1960 consumption will increase to about 15 million standard cases. The market least developed seems to be that of the North Central Area of the United States and the South. This may be determined from the data shown in figure 9. These areas have a much higher percentage of rural farm population. The relatively low use of canned tuna by that part of the United States population generally is shown in table 11. Farmers, particularly Negro farmers in the South, have built up a preference for canned salmon because of the relatively low price of certain types such as canned chum salmon. In addition, rural areas are not attractive for intensive selling effort because relatively less results per dollar of sales effort are usually obtained. Nevertheless, those areas offer the tuna canning industry the possibility of expanded sales if no effort is spared to determine and effect means of developing the canned tuna market.

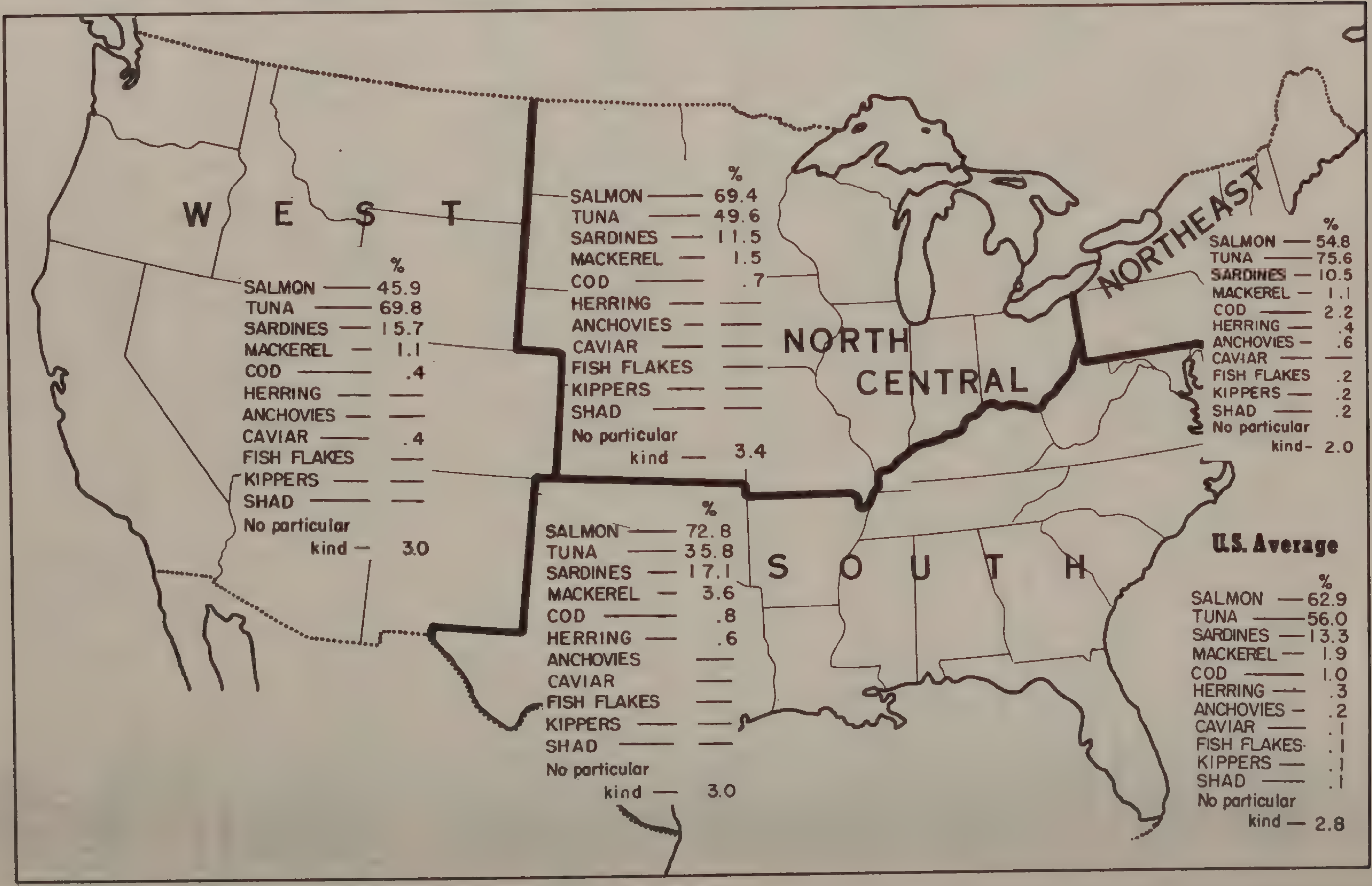
Foreign market development was also given consideration since some members of the tuna industry believe that markets can be developed for canned tuna in countries outside of the United States. Such possibilities may exist in isolated instances where a relatively small amount of trade in canned tuna may be developed. However, there is little liklihood that anything can be developed on a scale which would significantly change the present pattern of distribution for some time to come.

Outside of the United States there are only two other major tuna consuming countries in the world, Japan and Italy. The nature of markets for tuna in those countries is quite different than ours. The Japanese consume very little canned tuna, preferring other forms of tuna products. Italians consume canned tuna but in a much different style of pack than that which is marketed in the United States. Consumers in both Japan and Italy on the whole prefer the darker-meated tunas such as skipjack and bluefin and tunalike fishes such as bonito.

The most important canned tuna product consumed in Italy is tuna preserved in oil. This product is packed in what is known as "Italian Style". This particular type of pack is heavily salted and only olive oil is used as compared to the use of soya oil for the greater part of the pack processed and sold in the United States.

Figure 9

ESTIMATED PERCENTAGE OF HOUSEHOLDS SERVING VARIOUS KINDS OF CANNED FISHERY PRODUCTS DURING THE YEAR PRIOR TO OCTOBER 1, 1951.[1]



WEST
%
SALMON — 45.9
TUNA — 69.8
SARDINES — 15.7
MACKEREL — 1.1
COD — .4
HERRING — —
ANCHOVIES — —
CAVIAR — .4
FISH FLAKES —
KIPPERS — —
SHAD — —
No particular kind — 3.0
NORTH CENTRAL
%
SALMON — 69.4
TUNA — 49.6
SARDINES — 11.5
MACKEREL — 1.5
COD — .7
HERRING — —
ANCHOVIES — —
CAVIAR — —
FISH FLAKES —
KIPPERS — —
SHAD — —
No particular kind — 3.4
NORTHEAST
%
SALMON — 54.8
TUNA — 75.6
SARDINES — 10.5
MACKEREL — 1.1
COD — 2.2
HERRING — .4
ANCHOVIES — .6
CAVIAR —
FISH FLAKES .2
KIPPERS — .2
SHAD — .2
No particular kind - 2.0
SOUTH
%
SALMON — 72.8
TUNA — 35.8
SARDINES — 17.1
MACKEREL — 3.6
COD — .8
HERRING — .6
ANCHOVIES —
CAVIAR —
FISH FLAKES —
KIPPERS — —
SHAD — —
No particular kind — 3.0
U.S. Average
%
SALMON — 62.9
TUNA — 56.0
SARDINES — 13.3
MACKEREL — 1.9
COD — 1.0
HERRING — .3
ANCHOVIES — .2
CAVIAR — .1
FISH FLAKES .1
KIPPERS — .1
SHAD — .1
No particular kind — 2.8

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[1] Based on replies of 1922 households in the United States. Totals add to more [illegible] because a few respondents did not answer the question on which the

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TABLE 11. - PERCENTAGE OF HOMEMAKERS CONSUMING CANNED TUNA AND CANNED SALMON IN THE UNITED STATES IN YEAR PRIOR TO OCTOBER 1, 1951: BY CITY SIZE GROUP AND FARM AND NON-FARM

CITY SIZE	NO. OF HOME-MAKERS	NO. THAT USE TUNA	% IN CITY SIZE GROUP	% OF TOTAL USERS OF TUNA	NO. THAT USE SALMON	% IN CITY SIZE GROUP	% OF TOTAL USERS OF SALMON
500,000 and over..	516	272	52.7	25.4	254	49.2	21.0
50,000 - 499,999..	406	216	53.2	20.2	175	43.1	14.5
20,000 - 49,999...	620	302	48.7	28.2	308	49.7	25.5
Less than 20,000 and rural	931	280	30.0	26.2	470	50.5	39.0
Total	2473	1070	43.3	100.0	1207	48.7	100.0
Farm......	549	136	24.8	12.7	300	54.6	24.9
Non-farm..	1895	921	48.6	86.1	897	47.3	74.3
Blank,etc..	29	13	44.8	1.2	10	34.5	.8
Total	2473	1070	43.3	100.0	1207	48.7	100.0

The Japanese consume tuna raw sashimi and in the form of dried fillets or sticks which have been made from fish that is boned, steamed and smoked katsuobushi. Skipjack is the species used for both these products. In metropolitan Tokyo the opinion of middle-class wage earners is to the effect that albacore and other tunas are too high priced for the average Japanese. Food is the largest item in the Japanese wage earners' budget and lower priced species of fish other than tuna are readily available in the markets. Skipjack is one of the tunas which is priced at a level more in line with other inexpensive fish. Since it is a type of product desired by Japanese and somewhat inexpensive, the Japanese catch of skipjack is consumed domestically. Most canned fish, especially tuna, even that packed for the domestic market in Japan, is too high priced for the average Japanese family to purchase. Foreign sources estimate that Japanese consumption of canned tuna has dropped from a pre-war level of 30 percent of the Japanese pack to a current consumption of about 10 percent. This particular observation with respect to consumption of canned tuna in Japan may be applied generally to all the Asiatic nations. It is highly doubtful that any market for canned tuna could be developed in this area because of the relatively high price of the product.

The other principal area of the world where great populations are concentrated outside of North America and Asia is, of course, Europe. In Europe, Italy, as has been previously indicated, is a large tuna-consuming nation. Fish consumption has always been high in the United Kingdom. In the past that country has been an important market for canned salmon, principally from the United States, with some being imported from Canada, Japan, and the U.S.S.R. Since 1949, because of economic conditions, the United Kingdom has considerably curtailed imports of salmon. There has been an attempt to substitute canned tuna from various sources. Canned tuna has been imported from Chile, Peru, Portugal, Australia and other soft-currency countries. Turkey also has undertaken to supply the United Kingdom with canned tuna.

Some of the other European countries, such as Belgium, Switzerland, and France, also consume small amounts of canned tuna. However, the amounts are small indeed and Europe as a whole is not a tuna-eating area. Furthermore, foreign exchange difficulties bar significant market development at present. Any increased demand for canned tuna in Italy and any small increases in the remainder of Europe are likely to be supplied by foreign producers of the product, rather than the United States.

Domestic producers are indirectly benefitted when foreign suppliers export canned tuna to countries other than the United States because of lessened competition. This fact, however, would be considerably more meaningful to domestic producers if such opportunities were much greater than they are now.

STATISTICAL ANALYSIS OF TREND, CORRELATION ANALYSIS, ETC.

Important Factors Affecting the Demand For Canned Tuna

A detailed study of demand in the form of correlation and other statistical analyses was also undertaken in the work on tuna consumption done in this study. Economic and statistical study in this respect was supplemented with field contacts with distributors and others in the tuna industry. As a result, a specific analysis of factors affecting canned tuna consumption has been made. Before going into this analysis in its detail, a few generalizations about food consumption should be made.

The individual's purchases in the market are colored by tastes, income, and the relative prices of commodities available. In the broad classification of food commodities, there is a plentitude of products for the American consumer to choose from. The competition among foods is keener than in other classes of goods because of the physiological limitations of individual consumption aside from income considerations. Canned tuna is competing for the consumer's food dollar with all other food products. However, it competes most directly with other protein foods.

Those protein foods whose prices appear to have a stronger influence on canned tuna sales include fresh and frozen fish, meats, poultry, eggs, cheese, and all canned fish, particularly canned salmon. Interviews with distributors of canned tuna and salmon, as well as statistical analyses, point particularly to the close competitiveness between these two commodities. Recent smaller packs of salmon are one of the most important reasons for increased sales of canned tuna.

Per capita consumption of canned salmon (table 12) declined approximately 50 percent since 1941, while the per capita consumption of canned tuna tripled in the same period. The salmon pack has declined approximately three million standard cases from pre-war years because of diminished salmon runs. In this same period, the price of canned tuna declined in relation to that of canned salmon. This is indicated by the data in table 12. The per capita consumption of canned tuna increased, as is shown graphically in figure 10. Canned tuna became a more attractive buy for the consumer. Price played a dominant part in increasing tuna consumption, but the promotional work of the tuna industry, along with

TABLE 12. - U. S. AVERAGE PRICES AND PRICE RATIO OF CANNED TUNA AND TUNALIKE FISHES AND CANNED SALMON TOGETHER WITH PER CAPITA CONSUMPTION.

1930 - 1951

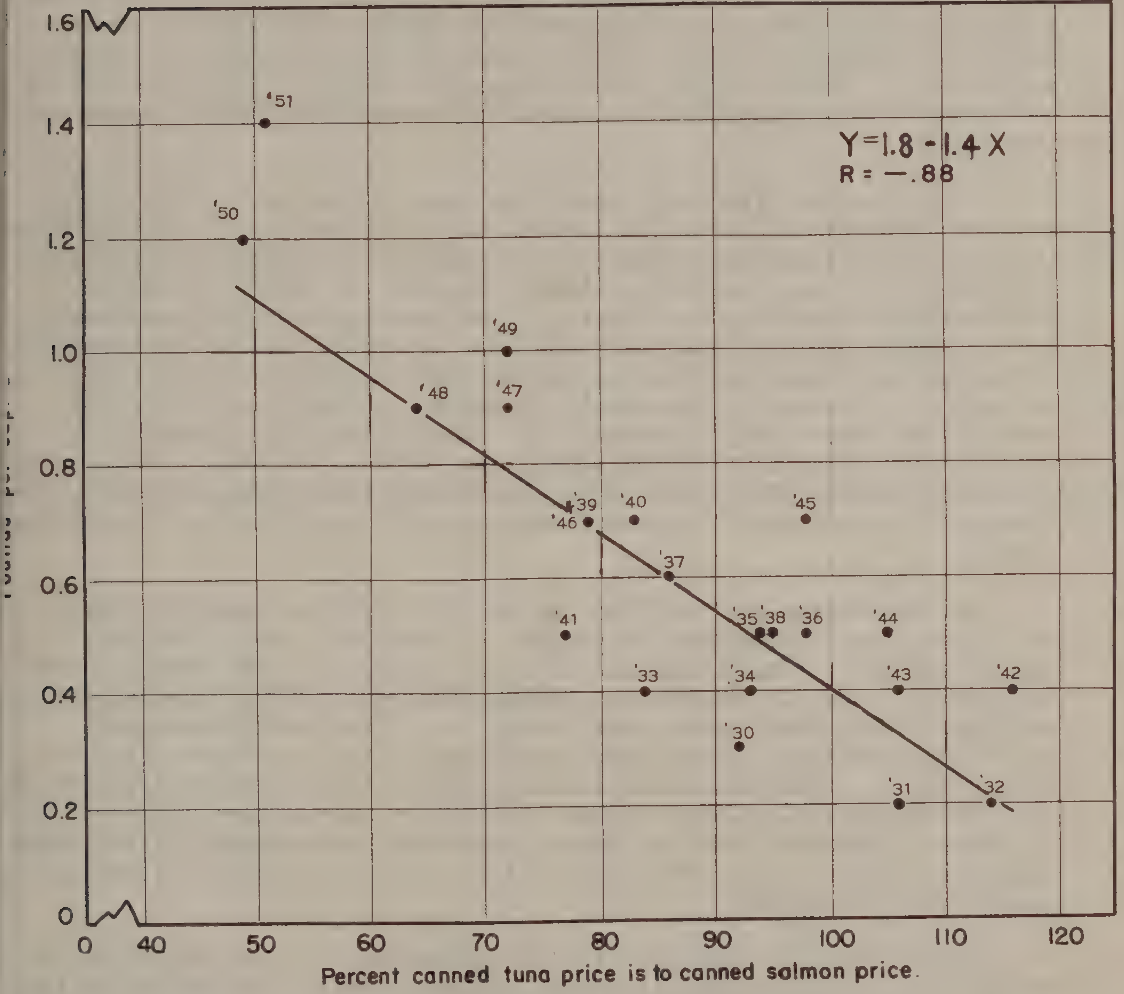
YEAR	AVERAGE PRICE PER STANDARD CASE		TUNA-SALMON RATIO	PER CAPITA CONSUMPTION CANNED TUNA 1/	PER CAPITA CONSUMPTION CANNED SALMON
	TUNA 1/	SALMON			
	Dollars	Dollars	Percent	Pounds	Pounds
1930	6.49	7.04	92	.3	2.0
1931	5.98	5.65	106	.2	2.1
1932	5.13	4.48	114	.2	2.2
1933	4.81	5.70	84	.4	2.2
1934	5.08	5.47	93	.4	2.3
1935	5.11	5.39	94	.5	2.2
1936	5.49	5.58	98	.5	3.4
1937	6.04	7.01	86	.6	1.9
1938	5.51	5.82	95	.5	2.9
1939	5.51	6.97	79	.7	2.1
1940	5.66	6.78	83	.7	1.9
1941	6.61	8.60	77	.5	2.8 2/
1942	12.37	10.62	116	.4	1.6 2/
1943	11.66	11.03	106	.4	.8
1944	11.47	10.97	105	.5	.7
1945	10.46	10.71	98	.7	.8
1946	12.36	15.56	79	.7	1.1
1947	15.37	21.38	72	.9	1.5
1948	16.00	24.98	64	.9	1.4
1949	13.40	18.72	72	1.0 3/	1.5 3/
1950	12.51	25.42	49	1.2 3/	1.4 3/
1951	12.02	23.34	51	1.4 3/	1.3 3/

1/ Includes tunalike fishes.
2/ May be too large; no data available on defense and war takings which had become significant by 1942.
3/ Preliminary.

SOURCE: U. S. Fish and Wildlife Service and
U. S. Bureau of Agricultural Economics.

Figure 10

RATIO CANNED TUNA PRICE[1] TO CANNED SALMON PRICE[2] RELATED TO PER CAPITA CANNED TUNA[3] CONSUMPTION, 1930-1951.



1/ Weighted average wholesale price all packs including tunalike fishes.

2/ Weighted average wholesale price all packs.

3/ Tuna and tunalike fishes.

Data from table 12.

U. S. FISH AND WILDLIFE SERVICE

the lack of similar activities on the part of the salmon industry, also probably had a significant influence. Canned tuna has been established as a staple product in most markets during the past decade under these favorable circumstances. No longer a specialty item, canned tuna has overtaken salmon in volume and value sold in many northeastern and western markets. There can be no doubt that the relatively high prices and low production of canned salmon had an important influence in bringing this about.

Other factors affecting demand also were developed in this study. In table 13 data are presented showing the relationship of tuna consumption by income groups as found in the recent Fish and Wildlife Service consumer preference survey previously referred to. Both this table and the data developed from the "1948 food consumption surveys" conducted by the Bureau of Human Nutrition and Home Economics of the U.S. Department of Agriculture shown in table 14 indicate that demand is elastic with respect to percentage of households consuming canned tuna throughout most of the income range covered. By "elastic demand" is meant the tendency for purchasers of canned tuna to increase rapidly with increases in family income. That is to say, in general, there are substantial increases in the number of households consuming canned tuna as income moves upward.

The tabulation for the Fish and Wildlife Service consumer preference survey has a breakdown by regions -- Northeast, North Central, South, and West. The boundaries of these regions are the same as shown in figures 3 and 9. The general pattern for each of the four regions was that of positive income elasticity. The South, throughout all income brackets, had a lower percentage of tuna consumers than the other regions. This situation in the South has been previously referred to. The Northeast and West showed the highest percentages of users. The survey indicates that as income increases, particularly in the lower brackets, canned tuna consumption will be expanded by bringing new consumers into the market.

While positive elasticity in the percentage of users may be noted, it should also be observed in table 14 that there is a tendency for the amount of canned tuna consumed to level off and become relatively stable in the higher income brackets. That table shows that as income increased in these brackets the quantity of tuna consumed per family varied only slightly. This tendency is a limiting factor on the over-all elasticity of demand for canned tuna. It is the influence of the physiological in that the human stomach will take just so much of a product. The income of consumers could be increased infinitely, or the price of canned tuna could be reduced tremendously, but there is a fixed limit to the amount of canned tuna which will be bought and consumed.

TABLE 13. - PERCENT OF HOUSEHOLDS IN VARIOUS INCOME GROUPS THAT USED CANNED TUNA DURING THE PERIOD OF ONE YEAR PRECEDING OCTOBER, 1951, BY REGIONS 1/ AND FOR THE UNITED STATES

INCOME GROUP	NORTHEAST		NORTH CENTRAL		SOUTH		WEST		UNITED STATES	
	total house-holds in group	per-cent using	total house-holds in group	per-cent using	total house-holds in group	per-cent using	total house-holds in group	per-cent using	total house-holds in group	per cent using
Under $1000	3	100.0	16	12.5	72	8.3	7	28.6	98	12.1
$1000-$1249	6	33.3	11	27.3	20	20.0	6	16.6	43	22.7
$1250-$1499	14	35.7	15	46.7	39	20.5	7	28.5	75	29.3
$1500-$1999	23	47.8	10	20.0	28	17.9	10	50.0	71	31.9
$2000-$2499	51	37.3	35	31.4	51	25.5	23	52.2	160	34.4
$2500-$2999	91	63.7	82	34.1	78	23.1	36	75.0	287	45.3
$3000-$3999	139	63.3	142	47.9	67	34.3	32	50.0	380	51.3
$4000-$4999	78	61.5	75	53.3	40	37.5	23	82.6	216	56.7
$5000-$7499	41	70.7	47	63.8	29	44.8	14	71.4	131	62.1
$7500-Over	27	74.1	17	58.8	12	58.3	9	66.6	65	66.1
Income not given	212	57.5	282	31.6	298	25.5	155	56.8	947	39.6
Total households in survey	685	60.0	732	39.6	734	25.1	322	58.4	2473	43.5

1/ For boundaries of regions see figures 3 and 9.

TABLE 14. - Consumption of canned tuna by city families in the U. S., 1948

Survey and family income class (dollars)	Households	Quantity consumed per household in a week	Quantity per household using any during week	Households using during 1 week
	Number	Pounds	Pounds	Percent
National Urban Survey Spring, 1948				
All classes	1,558	0.082	0.516	15.9
Under 1,000	53	.047	.415	11.3
1,000-1,999	204	.036	.495	7.4
2,000-2,999	410	.059	.484	12.2
3,000-3,999	351	.084	.498	16.8
4,000-4,999	167	.134	.558	24.0
5,000-7,499	154	.106	.564	18.8
7,500 and over	72	.106	.448	23.6
Not classified	147	.120	.570	21.1
Birmingham, Winter, 1948				
All clases	267	.030	.449	6.7
0-999	19	0	0	0
1,000-1,999	51	.025	.630	3.9
2,000-2,999	83	.023	.384	6.0
3,000-3,999	53	.061	.459	13.2
4,000 and over	44	.039	.425	9.1
Not classified	17	0	0	0
Buffalo, Winter, 1948				
All classes	258	.170	.541	31.4
0-1,999	23	.036	.410	8.7
2,000-2,999	95	.170	.557	30.5
3,000-3,999	76	.159	.525	30.3
4,000-5,999	44	.210	.485	43.2
6,000 and over	7	.063	.440	14.3
Not classified	13	.391	.726	53.8
Minneapolis-St. Paul Winter, 1948				
All classes	253	.119	.512	23.3
0-1,999	25	.030	.750	4.0
2,000-2,999	65	.090	.451	20.0
3,000-3,999	68	.157	.593	26.5
4,000-5,999	59	.137	.507	27.1
6,000 and over	26	.137	.445	30.8
Not classified	10	.123	.410	30.0
San Francisco, Winter, 1948				
All classes	288	.126	.477	26.4
0-1,999	18	.051	.455	11.1
2,000-2,999	62	.088	.453	19.4
3,000-3,999	86	.123	.461	26.7
4,000-5,999	58	.206	.520	39.7
6,000 and over	32	.137	.486	28.1
Not classified	32	.093	.427	21.9

SOURCE U.S. Bureau of Human Nutrition and Home Economics

The fact that increased income leads to greater use of canned tuna, and the fact that consumer incomes on the average have been relatively higher in the post-World War II years must account for some of the increased demand for canned tuna.

In addition, the influence of advertising should not be discounted. There have been much greater expenditures for direct advertising by the tuna processing industry in recent years. Estimates of their direct advertising expenditures are shown in table 15. Advertising and sales promotion can help to shift the intensity of demand upward by influencing the tastes of consumers. An increase in consumption can be gained by introducing new consumers to canned tuna and raising the per capita consumption of present consumers. The latter is now being attempted by promoting dishes which lift tuna from the strictly salad or sandwich category. However, because of the many competitive foods on the market it would appear that gaining new consumers might be more fruitful. Through advertising the intensity of demand for canned tuna might be further increased by changing slightly the food habits of consumers not now using canned tuna.

Analysis of Canned Tuna Consumption Trend

As has been indicated, there are many factors affecting the demand for canned tuna. To attempt to analyze all would have been a time-consuming and never-ending job. Yet, it is desired to make some judgment as to the marketing trend on a quantity basis. In this connection one further analysis is presented. Figure 11 shows the trend in consumption of canned tuna over the past 24 years, based on an average calculation which excludes the influence of the war years 1942-1945. These years were excluded because a great part of the larger boats in the fleet had been commandeered for war use by the armed forces. The actual apparent consumption data graphed in figure 11 are also shown in table 6. Affecting the trend which is shown on the chart are all the factors involved in the demand for canned tuna with no one of them specifically isolated. This trend indicates that in 1960 apparent consumption of canned tuna will amount to 292 million pounds. Taking 19.5 pounds as a conversion factor to standard cases this would amount to about 15 million standard cases as compared with slightly over 11 million standard cases in 1952. That is to say, if the same factors which have been at work in the past continue to operate in the future the estimate of 15 million standard cases should be valid.

Consumption of canned tuna can be expected to increase. It is interesting to note that on the basis of the estimated increase in our population canned tuna consumption may be expected to expand by about 10 percent from

TABLE 15. - ESTIMATED DIRECT ADVERTISING [1] EXPENDITURES OF THE TUNA PROCESSING INDUSTRY, 1946-52.

YEAR	DIRECT ADVERTISING EXPENDITURES	VALUE OF PRODUCTION	% DIRECT ADVERTISING IS OF VALUE OF PRODUCTION
	dollars	dollars	percent
1946	682,409	59,136,823	1.2
1947	787,937	90,609,175	.9
1948	1,039,738	112,612,296	1.4
1949	1,522,101	97,710,325	1.6
1950	3,082,798	112,830,094	2.7
1951	3,233,097	99,046,206	3.3
1952	3,660,000	113,000,833	3.3
TOTAL	14,008,080	684,945,752	2.1

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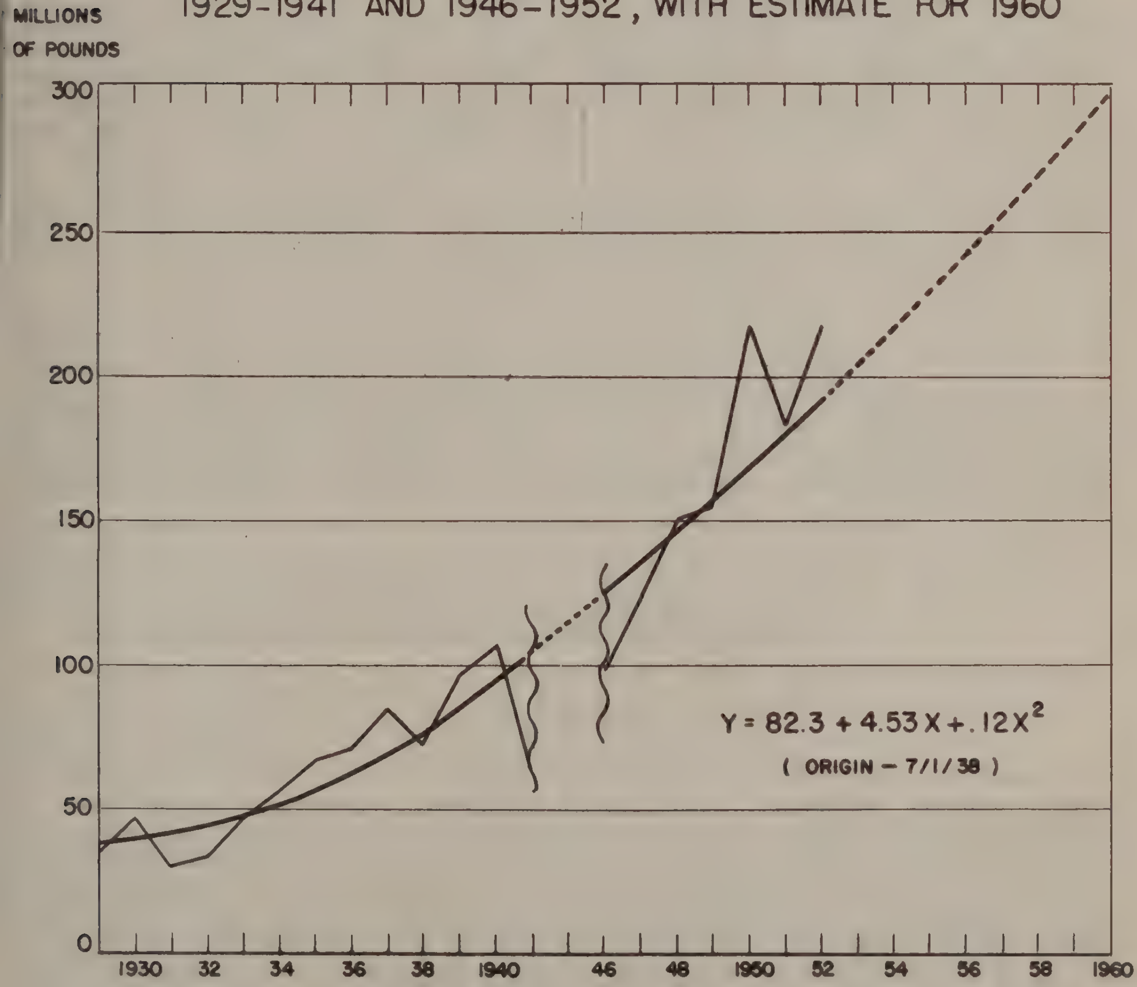
[1] Does not include advertising by local distributors for which allowances are made by processors, or any other type of advertising expenditure which may be made for products of the tuna industry.

Figure 11

CANNED TUNA AND TUNALIKE FISHES: APPARENT SUPPLY AVAILABLE FOR CONSUMPTION IN THE UNITED STATES, 1929-1941 AND 1946-1952, WITH ESTIMATE FOR 1960



Data from table 6

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1952-1960. This expectation assumes that consumption will continue at the same per capita level as in 1952, which was 1½ pounds per person. As compared to the 10 percent expension in consumption which can be expected solely on the basis of increased population, the estimated increase shown in figure 11, is much larger amounting to 36 percent. Factors other than the increase of population are expected to have a bearing on the 1960 volume of consumption.

It is believed that the price relationship of canned tuna to canned salmon will be a very important influencing factor with respect to the 1960 estimat The salmon runs are not expected to decline to the extent they have in the past decade, and are more likely to increase. However, the supply of canned salmon is not expected to exceed 6 million standard cases in any one year in this decad under favorable conditions and will average somewhat less. This compares with an average pack of 6,968,280 standard cases from 1931 to 1941. Also, high labor and material costs are unlikely to decline, and these rigid costs together with a limited supply will keep canned salmon prices from dropping very far. Even if the canned salmon industry launches a promotion campaign it is unlikely that it can regain all of the market that has been lost to canned tuna.

In addition to being influenced by the competitive situation with canned salmon the estimate graphed also assumes that national income will continue along present trends with employment at high levels. Greater promotional expenditures by the tuna industry and additional favorable circumstances can increase consumption to an even higher estimate. On the other hand unfavorable economic conditions such as decreased national income and unemployment would probably result in lower consumption.

OUTLOOK FOR THE CONSUMPTION OF CANNED TUNA AND OTHER TUNA PRODUCTS - IN 1953 - BEYOND 1953

Canned Tuna

Canned tuna has become a staple article of diet for certain purposes in certain areas, at least. As a base for salads, canned tuna of the usual oil pack and more recently in the brine pack, has been commonly and increaingly used for some time, over most of the country. The major increases doubtless occurred at times when canned salmon became scarce. Possibly the complete absence of canned crab meat from Japan during World War II was also a factor in this increase. The other staple use is in sandwiches, which may themselves be made of tuna salad or of a tuna "spread". Many sandwiches are sold at lunch counters and other establishments serving light meals.

As a staple protein base for hot dishes, tuna has not attained any great volume as yet. It is in the capture of a portion of this field that some further gains in per capita consumption may be made for the extent of use in salads and sandwiches is probably near its maximum unless eating habits shift further toward utilizing more of these forms of food.

It has also been pointed out that rural areas such as the southern and north central sections of the country consume much smaller amounts of canned tuna than urban areas. In spite of the difficulties involved in attempting to expand this market, the potentialities of its expansion are significant. With some effort on the part of the various segments of the industry concerned it is likely that more canned tuna could be sold in those areas in the future.

In a previous section it was indicated that there was little consumption of canned tuna in the very low income brackets, the highest use being in the middle and upper income households. Apparently an expansion of volume could be accomplished if it were possible to lower the price of the product. This has already occurred to some extent (see retail prices in chapter VII). Even if prices could be lowered further it is probably true that a considerable portion of the low-income groups would be difficult to reach by most major types of promotion so that the development of this market might be difficult and costly. However, the fact that low-income households use relatively small amounts of canned tuna points toward a means of disposal of the supply of canned tuna, should it become much greater than it has been. Probably there are better prospects of doing this through national efforts to raise the level of income of low-income households rather than through further sizable reductions in the prices of canned tuna.

A large number of variable factors will affect the future consumption of canned tuna. Some of these are mentioned below. However, other unsuspected influences may be at work or may come into operation later, as is often found in studies of economic activities.

In general, it may be said that canned tuna is a popular food in the United States and its popularity appears to be increasing. Although canned tunalike products, bonito and yellowtail, are not as popular with household consumers their use is increasing. Institutional users are purchasing these items more and more. The recent increases in per capita consumption point to the possibility of some further increases in consumption, if any appreciable effort is exerted to attain it. As to the immediate future, the year 1953, the probabilities point to an increase over 1952. This forecast is based primarily on the volume of canned tuna now available from the 1952 pack, normal results of fishing by the domestic fleet, and the continuance of imports of frozen tuna and canned tuna and bonito at a substantial level. It is presumed that determined and intelligent efforts will be made to step-up the distribution of tuna. If the new pack from domestically-caught tuna is substantially lower in volume than in 1952, the total available domestic supplies for the entire year 1953 will not be sufficient to provide the volume that could be absorbed by an expanding market.

Whatever may happen to domestic production of raw stock, we assume that supplies from other parts of the world, either canned abroad or canned in the United States from raw or other stock produced abroad, will increase the total supply to an amount ample for the needs of the domestic market. That is, we assume that the total quantity made available will meet any reasonable forecast of demand in the next few years and that the price will be low enough so that it will be absorbed by the market. In other words, although no more tuna can be consumed than that which is supplied, the interest and capacity of the consumer probably will be the limiting factor rather than the domestic production supplemented by supplies from abroad.

Foods Competing With Canned Tuna

The supplies of competing foods, particularly protein foods, are important factors affecting the consumption of canned tuna. Among these protein foods are meats, poultry, cheese, eggs, and types of canned fish other than tuna. Of these it may be said that the per capita volume of meat available for consumption is unlikely to greatly exceed that of 1952. Cattle numbers are extraordinarily high, but pork production in 1953 is likely to be at a lower level than in the previous year. The production of poultry meat as a specialized industry has been growing rapidly and it seems probable that production in this field will continue at a high level. Production of eggs per capita reached a high point in 1952 and is not likely to greatly exceed recent levels. The per capita production of dairy products, on the contrary, has been declining and seems likely to decrease for the next few years at least.

As to canned fish, the production of canned salmon, the major competitor of canned tuna, does not seem likely to increase greatly for the next few years. The sardine industry is so variable in its production that little that is significant can be said about the prospects. Maine sardine productio should average below that of 1952 in the next few years. It is possible that the development of anchovies as sardines may increase the supply from the Pacific coast. It is also probable that the California sardine, or pilchard, will stage some come-back. However, it seems unlikely that the pilchard will approach its previous peak in the foreseeable future. It does not seem probable that the pack of canned mackerel or of Pacific and jack mackerel will be increased very greatly nor that these products will prove a substitute for or competitor of canned tuna in the near future. In addition to an increased level of consumption of canned tuna in 1953 it is considered quite likely that successive increases in following years will occur to the 1960 level of consumption mentioned in the previous section.

Background of Demand for Canned Tuna

Consumer income is a major factor in the consumption of food, as is true of consumer goods in general. The income of consumers tends to vary with the volume of business activity. Wage earners' income, while it is dependent on rate of pay, hours worked, and the volume of employment, varies with economic activity rather directly. When economic activity is on a high plane, employment is at a high level, as is true at present, when the number employed is at a maximum and the volume of unemployment is at a minimum. Full employment brings high consumer income and increased purchasing power. When the purchasing power of consumers is large, the prospect for maintaining or increasing the consumption of a given food is facilitated. When consumer income and the consequent expenditures decline, the competition between foods is enhanced.

It seems unlikely that economic activity will continue at its present level indefinitely. In fact, many economists believe it will decline during 1953. The prospects for food production, however, are favorable. Consequently, it is anticipated that there will be increased competition between foods. In this competition, canned tuna is rather favorably situated because of its relatively low price as compared with many other protein foods. However, it is not as staple an article of diet as a number of other commodities in this class and it is a relatively recent addition to the diet of many consumers.

The development of specialty packs, such as smoked or spiced tuna, has made little progress in the United States. It does not seem likely that these packs will reach significant volume in relation to standard types of canned tuna.

Fresh and Frozen Tuna

Consumption of fresh and frozen tuna seems to be increasing somewhat. In recent years, fresh tuna has been marketed along the northern Atlantic seaboard during the season in which tuna was being caught in waters off New Jersey, New York, and New England. There is also some marketing of frozen tuna out of season. The tuna marketed at retail seems to have been chiefly bluefin and little tuna and one species seems to have substituted for the other, according to which was being caught most in the area or in the particular year or portion of the season. The demand seems to have come largely from consumers whose family or national background included a practice of using fresh tuna. Such consumers are largely from Mediterranean or Iberian countries or have their family origins in these areas. However, inquiries in New England indicated that others also consumed fresh and frozen tuna. One field investigator believed that fresh and frozen tuna "offer good prospects for market exploitation" in New England and New York City.

This trade in fresh and frozen tuna in the northeast has been so small that it has received little attention and would be difficult to measure. It is believed, however, that the volume has increased somewhat and that it could be further increased if the flow of supplies were more regular and if the species was designated so that variability in the character of the meat could be explained and allowed for in preparation for eating. Information on methods of cooking and canning such as that distributed by a California fishermen's union could be made available. With these aids, if promotion were undertaken, the use of fresh and frozen tuna might be increased considerably. However, it seems unlikely that such a promotion will occur. It does seem probable, nevertheless, that this trade will increase somewhat since tuna are now being landed and sold. Formerly they were not caught, or when caught were discarded, used as bait, or on occasion sold to reduction plants. As far as is known, tuna is not found in frozen form very generally in retail markets in the northeast, so that the season of widespread availability is short. It seems unlikely that serious attempts will be made in the near future to make frozen tuna generally available for an extended season.

On the west coast, the potentialities for the consumption of tuna in fresh form were indicated in the experimental distribution undertaken by a California fishermen's union in 1951. This occurred during an emergency period of declining prices for canning albacore, when the union was resisting the canner's reduction in the price of raw stock. These operations were conducted in central and southern California, starting in San Francis nd involved a considerable volume of albacore, about 1,250,000 pounds, hich was marketed fresh in a period of a few weeks. An effort was made o have the tuna sold through retail stores at a price no greater than 5 cents a pound and that seems to have been the standard practice. Recipes or cooking and instructions for freezing and canning were distributed ith the tuna. Here again there is little evidence available as to the urrent situation, that is, whether this distribution had a continuing ffect upon sales of fresh tuna or whether there is an increasing consumpion as time goes on. What information has been obtained is negative in haracter.

On the west coast, and particularly in California, there are considerble numbers of people with backgrounds in Mediterranean countries, as well s many Mexicans and people of Mexican origin who may also trace back to pain to some extent. In addition, there is a considerable element of riental origin, These national origins may have an effect on the possibility of increasing the consumption of fresh and frozen tuna in that area. It seems probable, in view of what is known of Oriental food preferences, hat such consumption might well expand among these people. Doubtless they ould make a marked distinction between the various species of tuna. Probably the reaction of people with origins in eastern Asia, such as those eriving from the Japanese, would be different from others, such as those springing from Philippine stock.

One phase of the consumption of fresh and frozen tuna should be mentioned, namely, the home canning of the product. Indications turned up in our inquiries point to some use of tuna for this purpose. It was estimated that about half of the 1,250,000 pounds sold fresh during the union's campaign in California in 1951 was utilized for home canning. The union also canned about 150,000 pounds for its members. However, little interest was shown in 1952 and it does not seem probable that the use of tuna for this purpose will reach any significant proportions.

The scanty information available from experiences in the distribution of fresh tuna would indicate that, if adequately promoted, several million pounds annually could be disposed of in this manner in the United States and that the price realized could be greater than that paid for raw stocks for commercial canning. The prospects are, however, that no such promotion will be undertaken and that commercial canning will continue to absorb practically all production and importation of tuna in fresh and frozen form.

Byproducts From Tuna

The production of oil and meal from tuna is distinctly a matter of disposing of byproducts incidental to the processing of the chief product of an industry. The variations in the market for byproducts are unlikely to appreciably affect the sales volume of the tuna industry as a whole or to be a principal factor in practices of the industry, because of the fact that the value of the byproducts produced by this industry is small compared to the value of canned products produced.

As to the future of markets for these products, it may be said briefly that the market for fish meal is expected to continue strong in 1953 and for several years thereafter. Fish meal has a peculiar adaptability to certain phases of the production of poultry and hatching eggs and to the production of swine. At present a small percentage of fish meal in feeds used in these industries is almost indispensable. The probability of the development of a substitute for the presently unknown nutrition factor in fish meal cannot be assessed accurately. This possibility, moreover, poses the chief reservation as to the future price scale and absorptive capacity of markets. It will probably be a matter of two years at a minimum before the factor can be identified and there exists the possibility that this will never be accomplished. Solving the problems of locating or synthesizing a substitute and its development commercially would consume additional time. Moreover, if the factor is isolated, it may nevertheless prove most efficient to obtain it by feeding fish meal.

The importation of fish meal, which in 1952 was at about the same level as our domestic production, may also affect the market for fish meal. At the moment, however, it is not thought that this volume will increase rapidly enough to seriously affect the market for domestic fish meal. This is not to say that the increases have not been phenomenal, from less than 10,000 tons in 1947 to nearly 130,000 in 1951, and over 200,000 tons in 1952.5/ A continuation of this rate of increase seems unlikely, and prices have so far not reacted unfavorably to supplies of this volume.

On the demand side, it should be mentioned that there has recently been a decline in the numbers of poultry and in the numbers of swine. However, the year-to-year fluctuations in the numbers of the types of animals that are oridinarily fed fish meal in their rations are not expected to be wide enough to make for marked changes in demand. A factor which should be mentioned is the increasing reliance on poultry meat derived from specialized feeding operations rather than from enterprises devoted primaril

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5/ Imports of some fish solubles may be included in these figures.

the production of eggs. This development tends to increase the proportion growing chicks and laying hens which are fed rations containing fish meal.

The market for fish oils is currently in the doldrums and there is no indication that the situation will change greatly in the next few years. The chief hopes for improvement in the market for fish oils seem to lie in the development of specialized uses and in the use of fish oils in feeds for various types of farm animals. Extensive use of fish oils in feeds hinges on the success of current and future research. No immediate prospects of successful substitution is in evidence. Further research may develop not only special uses for fish oils, but special uses for individual types of fish oils or for certain fractions or components of these oils. Here, again, no immediate prospects of success are observable.

In the meantime, certain unfavorable factors in the market situation are at work, and these, for the most part, affect the markets for inedible fats and oils rather generally. A major unfavorable factor is the development of what are called synthetic detergents, which have markedly decreased the demand for fats and oils for the manufacture of soaps. Another negative factor in demand is the increasing use of "rubber" bases or latex bases in paints, which has decreased the demand for oils in the industry.

The domestic market for fish livers has been weakening for several years. A major factor in the situation is the use of synthetic vitamins, the declining cost of which has been accompanied by increasing production and widespread substitution for vitamin-bearing fish-liver oils. Moreover, fish livers and fish-liver oils from other countries have been available in large volume and at low prices. Under the circumstances, which do not seem likely to change significantly for the better, the livers and viscera of tunas do not seem likely to provide an incentive to further tuna production or to provide alternative income for processors. The value of these particular byproducts and others is a minor factor in the operations of the industry when compared with its canned products.

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CHAPTER III -- WORLD PRODUCTION

ABSTRACT

Tunas comprise a renewable biological resource not limited to continental shelves and unknown in potential production.

Although much work has been done to discover tuna grounds and to develop methods of capture and use, the elementary biological features of the tunas are only beginning to be understood.

Occurrence of tuna in commercial quantities has been correlated with current patterns in warmer seas.

Upwellings of deep water provide nutrients favorable to the growth of plankton necessary as food for tunas or other animals eaten by tunas.

The principal areas now being fished are the Pacific Ocean near the coasts of Asia and North and South America, and the Atlantic and Mediterranean waters off southern and western Europe.

In some parts of the world (Peru, Angola, the east coast of Australia, the Norwegian Sea, and Northeast United States) development of tuna fisheries has begun, and substantial production has been achieved in some instances.

Unexplored areas favorable for the existence of commercial quantities of tuna appear to be in (1) the equatorial circulation of the Atlantic and Indian Oceans, (2) the northeastern Pacific gyral, (3) the current flowing northward off western Australia, and (4) the Gulf Stream where it meets the coastal waters along North America.

It is thought that landings can be maintained in heavily exploited areas and increased on a world-wide basis.

The United States catch could be greatly increased by adopting methods for taking subsurface stocks not now exploited, and by fishing new areas in the mid-Pacific.

In pre-World War II years the world's tuna industry was confined mainly to the seas around Japan, the Mediterranean and adjacent Atlantic Ocean, and the Pacific Ocean off Central America.

Japan, the United States, and Turkey together caught 88 percent of the entire production.

Since the war, the increased demand for canned tuna in the United States and Italy has stimulated world interest in the tuna fisheries.

Operations have been expanded and new industries have been developed, principally off the southern Pacific coast of the Americas and off western and northern Europe.

The world's catch increased from 825 million pounds in 1939 to over 1 billion pounds in 1951.

Further expansion is expected in presently productive areas and other warm

REGIONS.

EVEN WHERE RESOURCES ARE ABUNDANT, HOWEVER, THE RETURNS MUST BE LARGE ENOUGH TO JUSTIFY THE PURCHASE OF HIGH-PRICED VESSELS AND THE INSTALLATION OF REFRIGERATION AND CANNING FACILITIES.

BECAUSE OF THE RELATIVELY HIGH COST OF PRODUCING TUNA, CONTINUAL EXPANSION APPEARS TO BE LARGELY DEPENDENT ON THE MAINTENANCE AND ENLARGEMENT OF THE MORE HIGH-PRICED MARKETS FOR TUNA PRODUCTS.

THE UNITED STATES APPEARS TO BE THE TARGET FOR MUCH OF THE INCREASED PRODUCTION OF TUNAS CONTEMPLATED BY MANY COUNTRIES.

It has just been observed that tuna consumption in the United States is in a healthy state. The outlook is relatively bright for continued increase in consumption. To determine if the demands which have been pictured in the previous chapter will be satisfied, staff members of the Branch of Fishery Biology and the Branch of Commercial Fisheries of the Fish and Wildlife Service have reviewed in detail the production or catching of tuna. The term "production" as used in this and the following chapter is limited to the natural resource and things concerned with that resource up to the time tuna are landed. Occasionally information on processing may be given but this is done only to illustrate conditions of production by indirection. Processing, a later stage of the industry will be discussed in Chapter V.

BIOLOGICAL OUTLOOK FOR TUNA RESOURCES [6]

The tunas, as a group of fishes comprising a renewable biological resource, differ from all the other well-known and important food fishes such as the herring, cod, haddock, halibut, salmon, and mackerel in two important respects. They are not limited to broad shallow sea areas abutting continents and their ultimate potentials for production are completely unknown. Even the elementary features of their biology such as spawning, life history, and migrations are only beginning to be understood. Under the circumstances, any appraisal of the long-term outlook must be very tentative and in very unprecise terms

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6/ Tunalike species are not considered in this section.

Though tunas were fished in the Mediterranean and in Japan ever since prehistoric times, the large tuna fisheries of today are relatively recent developments. Only the home island fishery of Japan and the United States West coast fishery can be said to be well-developed. It is not known how much these two fisheries can continue to grow beyond their present size. In the Pacific Coast States area the landings (all species) grew from about 44,820,000 pounds in 1920 to 99,347,000 pounds in 1930, to 204,882,000 pounds in 1940, and to 389,852,000 pounds in 1950. Strictures on growth since 1950 seem related to marketing rather than production difficulties. If ~~any of the latter have~~ been partially effective in limiting growth it has been through scarcity of live bait rather than the scarcity of tuna. Nonetheless, one cannot expect to double the catch every decade indefinitely into the future, and it is possible that this particular fishery may have nearly reached its full development. Studies undertaken by the Inter-American Tropical Tuna Commission are directed toward examining this possibility. The tuna fishery of the Japanese home islands has grown more gradually over a longer period of time and similarly has reached a stage where further indefinite growth seems hardly likely.

On the other hand during the last two decades it has become evident that these two great tuna fishing areas are not the only sites of large tuna resources. Prewar and postwar Japanese fishing expeditions in the north Pacific convergence for albacore and in the equatorial countercurrent region for yellowfin tuna have opened up resources in the western half of the Pacific the potentials of which are not yet realized. For the eastern half of the Pacific it appears that the equatorial region offers even better possibilities and it can only be guessed that the eastern north Pacific gyral may harbor albacore stocks similar to those farther west in the north Pacific convergence.

The Japanese, in prewar years, had also penetrated the waters among the large island masses of southeast Asia with tuna fishing expeditions and are now resuming their activities in this direction. Their results suggest existence of large tuna stocks from the Solomons Island area on the east to the Indonesian archipelago on the west.

In the meantime development of still other tuna fisheries has begun in continental-adjacent seas in other parts of the world. These activities are along the west coast of South America (Peru), the west coast of Africa (Angola), the east coast of Australia, in the Norwegian Sea, and off northeast United States. In some instances these developments are in a tentative trial stage, in others substantial production has already been achieved. Some of the areas may prove to have only nominal possibilities, but others conceivably might support fisheries rivaling those of the Japanese islands or those of the American west coast.

There are in addition vast sea areas as yet totally unexplored for tuna possibilities. Our imperfect but growing stock of knowledge concerning the oceans and the tunas suggest that concentrations of these fish occur in regions marked by fairly definite types of ocean circulation. The essential features seem to be the propagation or the accumulation of planktonic organisms in unusual concentrations affording food directly to the tunas or to the small fishes, squids and other marine animals which in turn are fodder for the tunas. The apparently effective types of circulation are: mass upwellings off continental edges generated by certain prevailing wind systems, interfaces between major ocean water masses of contrasting hydrographic properties, divergence-convergence combinations related to wind systems, and other oceanic situations causing convergence if on sufficient scale. It is probable that the concentrations of tuna are roughly proportional to the intensity and stability of these circulation systems but also modified by particular biological requirements of the fish themselves. Since many of the regions with the above listed types of circulation have not been assayed as to intensity and there is little precise knowledge on the biological requirements of tuna, their effectiveness in supporting large tuna resources cannot be predicted.

Nonetheless, study of current charts of the oceans is impressive for the number of totally unexplored situations which seem to fill at least some of the requirements for supporting large tuna populations. For instance the equatorial circulation of the Atlantic and Indian Oceans may be expected to have a divergence-convergence system similar to that of the Pacific which has already proved effective in supporting a considerable tuna population. In the Atlantic and Indian Oceans, however, the systems are geographically shorter from east to west and the accumulated effect of winds with long fetch may therefore be less pronounced. Also with reversing monsoons in the Indian Ocean there may be seasonal interruptions which may destroy the integrity of the system periodically. The huge gyral in the northeastern Pacific may constitute an even more effective convergence than the more linear one stretching across the western north Pacific Ocean. The north flowing current at certain seasons along the west coast of Australia bears similarities to those off the west coasts of South America and Africa which have already proved to harbor tuna populations of note. Even the interface of the Gulf Stream and the coastal waters of our north Atlantic shores eventually prove to be akin to the impingement on adjacent waters the Kuroshio of Japan in supporting tuna, though it seems that the gnitude of the stock must be modest to have escaped notice so far.

Not only do there appear to be unexplored opportunities for tuna oduction in the geographic sense, but also in the sense of neglect- species, life history phases, and aggregational phases. These, too, volve the geography of distribution, but knowledge of the habits of e fish in relation to catching techniques in some instances and rket acceptance in others are the principal problems. This field of nsideration ramifies so extensively that it can only be touched upon re. On the west coast of North and Central America four species com- ise practically the entire United States catch: yellowfin, skipjack, bacore, and bluefin. Yet there are two others in the area which are mmon and if commercially sought might yield surprisingly large catches. ey are the "little tunny" (*Euthynnus lineata*) and the big-eyed tuna *rathunnus sibi*). The former is generally of smaller size than desir- ble and very dark fleshed; the latter is larger sized than desirable d similarly dark fleshed but not as extremely so. These could be awn upon eventually if a very great enlargement in demand should far tstrip the supply of the presently more desirable species.

The three species which form the mainstay of present supply, llowfin, skipjack, and albacore, are fished during only that segment f their life histories which might be termed late youth and early dulthood. The main bulk of the adults almost completely eludes cap- re in the American fishery. In part, this may be attributed to the ishing methods which are effective only for surface swimming fish. In art it is due to our ignorance as to where the major part of their dult life is spent. With increased knowledge of the age-connected abits of these fishes and employment of appropriate gear, new gains n catch might be drawn from the older components of the stocks al- eady fished in their younger phases.

In summary, biological considerations suggest that the outlook s favorable for sustaining the present tuna yield and perhaps increas- ng it manifold on a world-wide basis. The avenues of expansion for ur present largely developed fishery on the West Coast probably are ot most promising along continued growth in directions pursued in the ast, but in tapping new stocks. Geographically the most available ould be the eastern portion of the proved yellowfin stocks of the rans-Pacific equatorial zone and the hypothecated albacore stock of the eastern north Pacific gyral. Among methods of fishing not yet used the technically most available is the long line method so far utilized extensively only in the fisheries of Japan. This method may not only be necessary to the tapping of the geographically different stocks but it may also prove to be the means of drawing upon the adult phases of the presently utilized stocks. At the present time there seems to be no biological obstacle to continued increase in American tuna production. In fact the biological outlook in other parts of the world are so favorable that foreign competition is quite likely to intensify as other countries develop additional tuna resources while looking to the existing American market to absorb their product.

PRODUCTION OF VARIOUS COUNTRIES

For centuries tuna has been consumed fresh, smoked, or dried and salted in the Orient and in various western European and Mediterranean countries. During the past 50 years, however, the development of canned tuna products and the improvement of fishing vessels, gear, and techniques have profoundly changed the pattern of production and consumption in the world's tuna fisheries. With the creation of a strong demand for canned tuna, principally in the United States and in Italy, tuna and tunalike fishes have become one of the world's most important items in fish trade.

Although the species of tuna and closely allied forms are numerous, not all species have been taken in large commercial quantities. The skipjack is the most abundant, supplying approximately 40 percent of world tuna landings. The yellowfin tuna is second in importance; world landings have been about 20 percent of the total. Albacore landings are about half those of yellowfin tuna. Of the remaining tuna species the most important are the bluefin of the Atlantic, Mediterranean, and the eastern Pacific and the black or oriental tuna (*Thunnus orientalis*)of Japanese waters. Presently, Japan is the only country fishing for the big-eyed tuna; other species of big-eyed tuna are known to exist in other parts of the world and undoubtedly they will be taken commercially as new tuna fisheries are developed. In recent years the little tuna (*Euthynnus* sp.) has been taken in larger but not yet commercially important amounts. Closely allied to the tunas are the tunalike bonitos (*Sarda* sp.): in certain countries (Turkey, Peru) they are the most important of the tuna and tunalike species taken.

Although the tuna and tunalike fishes are world-wide in distribuion and occur abundantly in most tropical and temperate waters, the ajor areas of production before World War II were centered in: 1) The astern Pacific from California to Ecuador, 2) the coastal and nearby ffshore waters along the Japanese islands, 3) the eastern Atlantic ff Portugal, Spain, and France, and 4) the Mediterranean area, particuarly near Sicily and North Africa and in the vicinity of the Dardanlles. The opening of a large tuna market in the United States during he 1930's stimulated much exploration and development in various parts f the world and new fishing grounds came into prominence. Among the oremost developments before World War II were the Japanese discoveries f albacore grounds in the mid-Pacific and yellowfin tuna grounds in he southwest Pacific.

In 1939 over 825 million pounds of tuna and tunalike fishes were anded; almost half of this amount was taken by Japanese fishermen. ext in importance were the landings by the United States tuna fleet, ccounting for 22 percent of the world's total. Turkish landings, rincipally bonito, were estimated to be about 16 percent of the world otal during the 1930's. Western European countries (France, Spain, nd Portugal) were fourth in importance with landings amounting to lightly over 8 percent of the world's tuna catch. The remainder of he landings were made by numerous other countries which caught tuna ncidentally or commercially in small amounts to supply foreign markets r local processing industries.

A major change in the world pattern of tuna production occurred uring and after World War II. The need for animal protein food durng the war and the interest shown by Latin American countries in devloping their tuna and bonito fisheries were mainly responsible for ncreased landings in Peru and Chile. Japan, which dominated the exort of canned and frozen tuna to the United States before World War II, as recently increased this trade and is now extensively fishing the lbacore and yellowfin tuna grounds that were partially exploited efore the war. It is now able to supply both home and foreign markets lmost at will.

In 1951 world tuna production increased to over 1 billion pounds, apan again being the leading producer with approximately 36 percent f world landings. The United States had a larger share of the world andings than in 1939, its fleet supplying about 32 percent of the orld's total. Peru has shown the most striking increase in landings--rom 0.2 percent in 1939 to nearly 13 percent of the world's supply in

1951. Increased landings by western European countries, amounting to 11.1 percent of the world catch, have enabled them to supply the large Italian market for canned tuna. Turkey was also an important producer (3.4 percent), but actual landings have declined to approximately one-fourth of the prewar landings. Norwegian landings of tuna have increased from an insignificant amount to slightly over one percent of the world total. Although many other countries have shown an interest in producing tuna (primarily for export to the United States), their tuna fisheries have not been expanded. In table 16, landings of tuna and tunalike fishes are given for those countries for which data are available. These data are illustrated graphically in figures 12 and 13. It is believed that the total landing figures approximate the actual total world landings, since those countries omitted conduct exceedingly small tuna fisheries, if any at all.

Gradual expansion of the tuna fisheries appears probable by those countries which are now the largest producers and by other countries located near extensive but little utilized tuna resources. The main obstacle to development in countries without progressive modern fishing industries is lack of capital for building vessels needed for high-seas operations and for establishing shore-based facilities to can or freeze the catch. For some countries tuna has become too high priced for local consumption, mainly because operating costs for high-seas vessels are high. Therefore, a large part of the world's increased production has been channeled into the more favorably priced United States market. Significantly, as Japanese production costs and exports have increased, the price of tuna on the local market has risen and consumption has dropped. The United States undoubtedly is the target for much of the increased production of tunas contemplated by many countries.

Peru, with large quantities of bonito available in its coastal waters, can be expected to increase production of this species even though its fishing fleet is primarily composed of comparatively small vessels. Chile and Ecuador are capable of increasing their tuna landings, but lack experience and capital. Along the east coast of South America tuna and tunalike fishes are now taken in small amounts. Development awaits exploratory fishing to determine the size and availability of the stocks in offshore waters. Furthermore, countries such as Venezuela and Brazil would be faced with the problem of marketing comparatively high priced tuna locally (in competition with salted cod) or developing export markets.

TABLE 16. - LANDINGS OF TUNA AND TUNALIKE FISHES BY AREA AND COUNTRY, 1939 AND 1951, EXCEPT AS NOTED

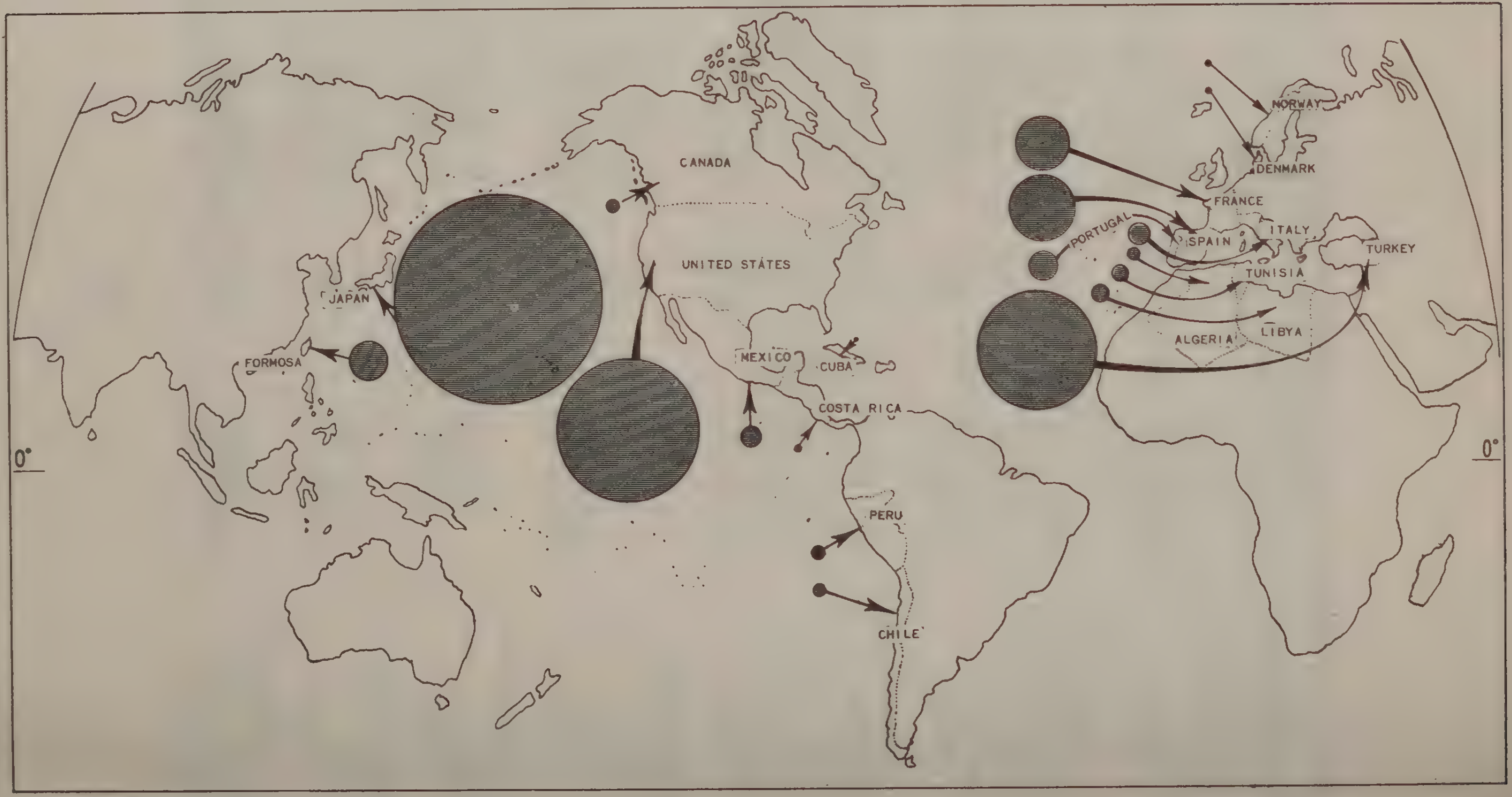
Area and country	1939		1951	
	Pounds	Percent	Pounds	Percent
Western Pacific				
Japan	411,095,790	49.8	362,989,305	35.6
Formosa	14,764,680(1936)	1.8	15,121,890 (1948)	1.5
Total	425,860,470	51.6	378,111,195	37.1
North America				
United States	182,604,870	22.1	1/324,105,000	31.8
Mexico	3,466,000(1940)	0.4	1,636,000	0.2
Canada	1,265,670	0.2	659,400	(2)
Cuba 1/	85,000(1940)	(2)	3,000,000(1952)	0.3
Total	187,421,540	22.7	329,400,400	32.3
Mediterranean Sea				
Turkey1/	132,000,000(1938)	16.0	34,200,000(1945)	3.4
Italy	3,647,070	0.5	6,376,860	0.6
Libya	2,734,200(1936)	0.3	2,224,845(1948)	0.2
Tunisia	1,658,160(1937)	0.2	952,560(1950)	0.1
Algeria	738,675(1936)	(2)	1,741,950(1947)	0.2
Total	140,778,105	17.0	45,496,215	4.5
Western Europe				
Spain	35,271,000	4.3	71,305,000	7.0
France	26,274,780(1938)	3.2	33,075,000	3.2
Portugal	6,203,000	0.8	3,929,000	0.4
Total	67,748,780	8.3	108,309,000	10.6
Northern Europe				
Norway	306,495	(2)	11,545,380	1.1
Denmark	304,290	(2)	2,723,175	0.3
Total	610,785	(2)	14,268,555	1.4
South America				
Peru	1,293,012	0.2	131,171,040	12.8
Chile	1,320,795	0.2	10,295,145	1.0
Total	2,613,807	0.4	141,466,185	13.8
Central America				
Costa Rica1/	550,000	(2)	3,400,000	0.3
Grand Total	825,583,487	100.0	1,020,451,550	100.0

1/ Estimated
2/ Less than 0.1 percent

Figure 12

1939 WORLD LANDINGS OF TUNA AND TUNA-LIKE FISHES BY COUNTRIES

APPROXIMATE TOTAL LANDINGS — 825,000,000 POUNDS

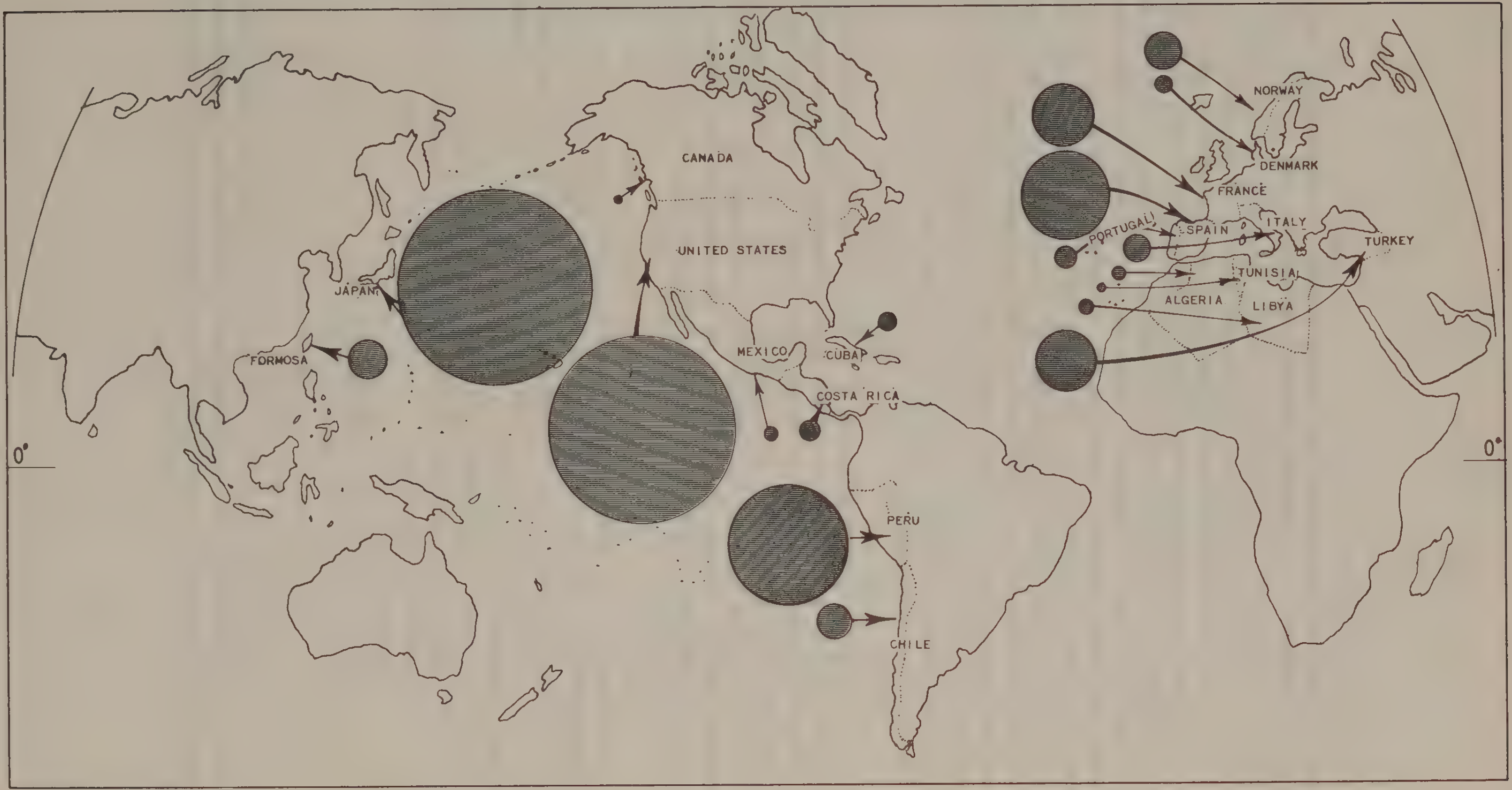

NORWAY
DENMARK
FRANCE
PORTUGAL
SPAIN
ITALY
TURKEY
TUNISIA
ALGERIA
LIBYA
CANADA
UNITED STATES
MEXICO
CUBA
COSTA RICA
PERU
CHILE
JAPAN
FORMOSA
0°
0°

Data from table 16

Figure 13

1951 WORLD LANDINGS OF TUNA AND TUNA-LIKE FISHES BY COUNTRIES

APPROXIMATE TOTAL LANDINGS – 1,020,000,000 POUNDS


NORWAY
DENMARK
FRANCE
PORTUGAL
SPAIN
ITALY
TURKEY
TUNISIA
ALGERIA
LIBYA
CANADA
UNITED STATES
MEXICO
CUBA
COSTA RICA
PERU
CHILE
JAPAN
FORMOSA
0°
0°

Data from table 16

U. S. FISH AND WILDLIFE SERVICE

The Indo-Pacific region has great possibilities for developing tuna fisheries comparable to those of the leading world producers. Before World War II extensive tuna resources were discovered by the Japanese in Indonesian, Indian, and Philippine waters. The people of this region now utilize only those tunas that can be caught close to shore with their simple fishing gear. Indonesia, India, and the Philippines are conscious of their offshore fishery resources and are attempting to organize the industry necessary to produce adequate amounts of tuna for domestic consumption as well as for export. Along the east African and Arabian coasts of the Indian Ocean tunas have been caught and dried, and/or salted for local consumption or for shipment to India and Ceylon, and before World War II processing factories were established in Italian Somaliland. Australia has been exploring its tuna resources, and is in the initial stages of developing an industry that will provide canned tuna for local consumption and for export either to the United States or to the British Isles.

In other areas of the world similar increased utilization of the tuna resources is also under way. Norway, with reported landings of about 22 million pounds in 1952, is capable of building or adapting shore facilities for processing canned tuna, and may be expected to increase production further. Along the west African coast, Angola appears to be a likely place for the development of large tuna fisheries and, aided by the Portuguese, it is providing some canned tuna for the Italian market.

Following are detailed discussions of the tuna fisheries in those countries for which information is available. Catch, processing, and export data are given where available. In addition to sources cited in the bibliography, Foreign Service despatches of the United States Department of State have provided much of the information given in the balance of this section. The United States tuna fisheries are not discussed in this chapter. They will be considered in greater detail in the next chapter.

Western Pacific

JAPAN

Tuna has always been a staple food in the Japanese diet, and, except for the period during and immediately after World War II, Japan has been the world's leading producer of tuna and tunalike fishes.

until the advent of motorized vessels, operations were conducted mainly in coastal waters for skipjack and other tunas, such as the black tuna, yellowfin tuna, and the albacore. Production increased sharply after World War I, but it was not until after 1925 (when Japan exported its first shipment of frozen albacore) that the industry assumed a position wherein it supplied both local and foreign markets. Although the major catch during the late 1920's and the decade following continued to come from Japanese coastal and nearby offshore waters, the fisheries were expanded to overseas areas. Important tuna grounds were developed in the mid-Pacific (near Midway Island), where albacore and the big-eyed tuna are taken, and in the southwest Pacific, where the yellowfin tuna is the important commercial species.

Japan's catch of skipjack, other tunas, and tunalike fishes, rose from about 135,000,000 pounds in 1908 to 290,830,680 pounds in 1930. Production, stimulated by the increasing mechanization of vessels, the increased local demand for tuna, and the development of foreign markets for frozen or canned tuna, increased to 446,369,175 pounds in 1940. The skipjack continued to be the most important species, mainly because of the large local demand for the processed skipjack stick Katsuobushi; the catch of skipjack during the 1930's was between 60 percent and 70 percent of total tuna and tunalike landings. Other tuna species, such as the black tuna, the big-eyed tuna, and yellowfin were also taken in increasing amounts, mainly for local consumption as raw tuna. Albacore, not well liked by the Japanese, was the main species taken for the export market. During World War II catches declined sharply, especially from offshore waters. Immediately after 1945, however, tuna fishing was resumed in the coastal and offshore waters authorized for fishing by the Supreme Commander for the Allied Powers (SCAP).

After World War II the tuna fisheries afforded Japan an opportunity to accumulate foreign credits. Important salmon and crab fishing grounds were lost, but the fishing areas authorized by SCAP were capable of producing 90 percent of the annual prewar Japanese tuna catch. The postwar Japanese tuna fleet was restored rapidly, not only through the efforts of tuna operators to enter a lucrative trade but through official support by the Japanese Government and the occupation authorities. By 1947, when 1,314 tuna vessels (totaling 78,517 gross tons) were operated, the fleet was larger than that operated before the war. In 1951 the tuna fleet consisted of 1,698 vessels (totaling 103,978 gross tons), compared with 1,038 vessels (totaling 52,665 gross tons) in 1940. Individual vessel tonnage of the postwar fleet is larger, and these vessels are capable of operating at greater distances in offshore waters.

A new trend has been the mothership tuna expeditions that have been sent to the southwestern Pacific. The first expedition was authorized by SCAP on May 11, 1950; nine expeditions operated in a limited area in the southwestern Pacific from June 1950 to November 1951 and produced approximately 38,500,000 pounds of tuna, marlin, shark, and other fishes. Two expeditions operated in 1952, catching 14,250,000 pounds of fish (about 60 percent yellowfin). The trend toward a larger tuna fleet, using larger vessels and mothership-type operations, makes it possible for Japan to supply increasing amounts of those species (albacore and yellowfin mainly) which are the principal export products in the tuna trade. At the same time home markets can be supplied with the tunas preferred by the Japanese.

The postwar rehabilitation and reconstruction of the Japanese fishing industry, as a whole, has been made possible primarily by Japanese Government official assistance, private bank financing and, since 1949, by the use of United States Counterpart Funds. In the fiscal year ending March 31,1951 the Japanese Government disbursed, out of United States Counterpart Funds, a total of 380,000,000 yen for the establishment of new freezing plants, cold-storage plants, and ice factories. Of this total, about 100,000,000 yen was specifically intended for processing fresh or frozen tuna for export. No disbursement from the Counterpart Fund was made for this purpose in the fiscal year ending March 1952.

The landings of tuna and tunalike species in Japan are shown in table 17. They indicate that in 1952 the Japanese tuna fisheries were likely to exceed their pre-World War II production.

The large tuna export trade developed by Japan is based mainly on species not in great demand locally, with the exception of yellowfin. Consequently, a marked increase in the catch of albacore and yellowfin has taken place, as shown in table 18.

Tuna was first canned in oil experimentally in Japan in 1906. Progress was slow, and an annual production of only 3,000 to 4,000 cases was attained by 1919. No tuna was canned between 1920 and 1929 except on an experimental basis. In 1930, a cannery was established at Shimizu for the production of tuna in oil, to be exported to the United States where the decline in albacore landings created

TABLE 17. - JAPAN: LANDINGS OF TUNA AND TUNALIKE FISHES, 1930-1952

YEAR	FROM COASTAL WATERS	FROM OFFSHORE WATERS	TOTAL
	POUNDS	POUNDS	POUNDS
1930	70,390,215	220,440,465	290,830,680
1931	67,764,060	253,019,340	320,783,400
1932	74,253,375	205,966,845	280,220,220
1933	74,191,635	235,573,380	309,765,015
1934	83,977,425	231,419,160	315,396,585
1935	99,613,080	212,087,925	311,701,005
1936	108,084,690	282,193,695	390,278,385
1937	83,794,410	286,808,760	370,603,170
1938	74,469,465	318,437,280	392,906,745
1939	107,674,560	303,421,230	411,095,790
1940	139,805,820	306,563,355	446,369,175
1941	303,743,160 1/	(1)	303,743,160
1942	276,495,975 1/	(1)	276,495,975
1943	199,746,540 1/	(1)	199,746,540
1944	96,799,500	63,724,500	160,524,000
1945	50,274,000	17,860,500	68,134,500
1946	81,635,715 1/	(1)	81,635,715
1947	(2)	(2)	276,432,030
1948	(2)	(2)	223,745,760
1949	(2)	(2)	269,331,930
1950	(2)	(2)	306,653,760
1951	(2)	(2)	362,989,305
1952 3/	(2)	(2)	430,038,945

1/ Catch from offshore waters included with coastal waters

2/ Not available.

3/ January to September only.

TABLE 18.- JAPAN: LANDINGS OF SELECTED SPECIES OF TUNA, 1936-1940 AND 1950-1952

YEAR	SKIPJACK	ALBACORE	YELLOWFIN TUNA	BLACK TUNA	BIG-EYED TUNA
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
1936	271,936,035	47,158,335	7,225,785	46,948,860	10,564,155
1937	282,297,330	59,254,965	7,029,549	51,993,900	25,871,265
1938	188,584,830	64,339,695	233,730	9,466,065	27,271,440
1939	218,255,310	37,637,145	17,626,770	38,483,865	15,968,610
1940	235,121,355	40,660,200	12,579,525	44,911,440	12,004,020
1950	186,498,900	65,256,975	22,623,300	10,244,430	21,860,370
1951	229,992,525	65,997,855	27,000,225	12,998,475	27,000,225
1952 1/	199,876,635	124,229,700	28,867,860	(2)	(2)

1/ January to September only

2/ Not available.

a market for the Japanese product. Favorable acceptance of canned white-meat tuna on the American market led to the establishment of other canneries, and the number increased to 16 in 1932. Three types of products were prepared: 1) white-meat tuna in oil, 2) tuna in brine, and 3) white-meat tuna seasoned (sugar and soy sauce added to albacore scraps), the latter two products primarily for local consumption or for export to other oriental countries. Production of canned tuna for the pre-World War II period is given in table 19.

TABLE 19. - JAPAN: PRODUCTION OF CANNED TUNA 1931-1940

YEAR	PRODUCTION CASES
1931	128,500
1932	364,799
1933	820,388
1934	396,195
1935	456,585
1936	438,500
1937	712,112
1938	807,924
1939	851,442
1940	967,056

NOTE: Cases consist of 48 460-gram cans or 96 235-gram cans.

Nearly 80 percent of the approximately 6,000,000 cases of canned tuna prepared from 1931 to 1940 was exported, almost two-thirds to the United States, with Canada, China, and Europe the next most important outlets. The peak of this trade was reached in 1933 when 670,004 cases (all white-meat tuna) were exported to the United States. The American tuna industry expressed concern over the possibility of the foreign product displacing American canned tuna, and the Presidential proclamation, effective January 13, 1934, increased the import duty on canned tuna from 30 percent to 45 percent ad valorem.

The post World War II tuna canning industry produced 1,299 cases of 48 8-ounce cans in 1946 and 7,169 cases in 1947. Thereafter, production increased rapidly as new canneries were put into operation. In 1950, 61 canneries, employing 9,880 people, were engaged primarily in processing fish; production of canned tuna by these plants was 2,603,891 cases, of which 1,406,130 cases were packed in oil. At that time the United States duty on canned tuna in oil was 22-1/2 percent ad valorem. Following the reimposition, on January 1, 1951, of the 45 percent duty on canned tuna in oil imported into the United States, production declined to 1,191,300 cases, of which 352,000 were packed in oil. During 1951, 59 plants (with an annual production capacity of 2,205,840 cases) were in operation, but by December 1951, only 10 canneries, employing 941 people, were canning tuna. The production of canned tuna by the Japanese for recent years is shown in table 20:

TABLE 20.- JAPAN: PRODUCTION OF CANNED TUNA 1948-1951 1/

ITEM	1948 CASES	1949 CASES	1950 CASES	1951 1/ CASES
IN OIL				
ALBACORE............	(2)	(2)	605,358	185,000
OTHER...............	(2)	(2)	800,772	167,500
TOTAL.......	75,670	205,047	1,406,130	352,500
IN BRINE				
ALBACORE............	(2)	(2)	85,632	255,000
OTHER...............	(2)	(2)	7,470	148,000
TOTAL.......	(2)	(2)	93,102	403,000
CHUNKS WITH SEASONING (SUGAR AND SOY SAUCE)				
ALBACORE............	(2)	(2)	64,145	65,000
OTHER...............	(2)	(2)	134,582	135,000
TOTAL.......	19,220	139,674	198,727	200,000
FLAKES WITH SEASONING				
ALBACORE............	(2)	(2)	482,146	147,200
SKIPJACK............	(2)	(2)	403,887	(88,600
YELLOWFIN	(2)	(2)	19,899	(
TOTAL.......	(2)	(2)	905,932	235,800
GRAND TOTAL.....	162,694 3/	626,106 4/	2,603,891	1,191,300

1/ December 1951 production estimated. Cases are 48 7-ounce cans.
2/ Not available
3/ Includes 67,804 cases of skipjack, type of pack not given.
4/ Includes 281,385 cases of skipjack, type of pack not given.

In 1950, 95 percent of the 1,527,376 cases of canned tuna exported by Japan were sent to the United States, the remainder mainly to Canada and Africa. In 1951, when the duty on canned tuna in oil imported into the United States rose to 45 percent ad valorem

Japanese exports declined over 50 percent to 719,120 cases. Since the duty on tuna in brine was only 12-1/2 percent ad valorem, the Japanese prepared larger amounts of this product, principally for export to the United States. Exports of tuna in brine were about half the canned tuna exports. This change-over in the type of product prepared for export illustrates the versatility of the Japanese tuna operators. In 1952, exports increased to 1,084,080 cases, over 70 percent being brine packed. The Japanese exports of canned tuna for 1950, 1951, and 1952 are shown in table 21:

TABLE 21. - JAPAN: EXPORTS OF CANNED TUNA 1950-1952

	1950		1951		1952	
	TO THE UNITED STATES	TO OTHR COUNTRIES	TO THE UNITED STATES	TO OTHER COUNTRIES	TO THE UNITED STATES	TO OTHER COUNTRIES
	CASES	CASES	CASES	CASES	CASES	CASES
WHITE-MEAT TUNA IN OIL......	629,359	19,391	115,700	56,000	152,362	82,893
LIGHT-MEAT TUNA IN OIL.....	804,265	51,776	109,950	57,490	363	34,414
WHITE-MEAT TUNA IN BRINE....	7,693	-	225,900	930	578,762	2,872
LIGHT-MEAT TUNA IN BRINE....	5,084	-	142,050	5,900	194,726	2,701
WHITE-MEAT TUNA FLAKES, SEASONED	-	8,876	-	5,200	32,402	700
LIGHT-MEAT TUNA FLAKES, SEASONED	-	932	-	-	1,535	350
TOTAL.......	1,446,401	80,975	593,600	125,520	960,150	123,930

NOTE: Cases are reported on a basis of 48 7-ounce cans.

The export of frozen tuna to the United States, first tried on a modest basis during the late 1920's reached sizable amounts during the following decade. Table 22 shows the pre-World War II exports of albacore and skipjack for the years 1929-1939.

After World War II, trade in frozen tuna was not resumed until occupation authorities permitted its export in 1948. In that year 2,451,960 pounds of frozen tuna was exported, and in 1949 the amount was increased to 3,210,480 pounds. The necessary plant expansion required for producing larger amounts of frozen tuna was undertaken during 1950 and 1951, assisted by United States Counterpart Funds. In 1951,

TABLE 22. - JAPAN: EXPORT OF FROZEN TUNA, 1929-1939

YEAR	ALBACORE POUNDS	SKIPJACK POUNDS	TOTAL POUNDS
1929	7,084,665	-	7,084,665
1930	9,377,865	-	9,377,865
1931	7,344,855	-	7,344,855
1932	2,548,980	-	2,548,980
1933	3,397,905	-	3,397,905
1934	4,140,990	-	4,140,990
1935	6,888,420	-	6,888,420
1936	5,856,480	-	5,856,480
1937	7,424,235	5,005,350	12,429,585
1938	4,507,020	4,800,285	9,307,305
1939	7,064,820	1,144,395	8,209,215

73 tuna-freezing plants were in operation, compared with 31 in 1937. In table 23 are shown the amounts of frozen tuna exported during 1950, 1951, and 1952.

TABLE 23. - JAPAN: EXPORTS OF FROZEN TUNA, 1950-1952

	1950		1951		1952	
SPECIES	TO THE UNITED STATES	TO CANADA	TO THE UNITED STATES	TO CANADA	TO THE UNITED STATES	TO CANADA
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
ALBACORE	12,941,145	1,717,695	28,945,035	3,053,925	37,520,000	5,736,000
SKIPJACK	3,442,005	-	3,001,005	-	1,166,000	-
YELLOWFIN	2,449,755	-	1,999,935	-	6,614,000	-
TOTAL	18,832,905	1,717,695	33,945,975	3,053,925	45,300,000	5,736,000

The Japanese Government now exercises control over tuna exports. On September 25 1951, canned white- and light-meat tuna were placed on the list of commodities for which export licenses are required. On December 15,1951, frozen tuna was added to the list. On April 7,1952, a quota for the export of tuna to the United States was established for the period April 1,1952 to March 31,1953. The quota covers both frozen tuna and canned tuna. Subsequent to the establishment of the original amount of the quota , several increases in the amounts allocated for frozen tuna were made and one increase was made in the amount allocated for canned tuna.

It is reported that the Japanese Government will continue its policy of developing the tuna fisheries. Since the country has surplus trade credit with the sterling bloc and with some of the soft currency countries, the only market for high-priced tuna are believed to be the United States and Canada. Even the Far Eastern countries, which took sizable amounts of seasoned tuna before World War II, no longer import this lower priced tuna product in any quantity. The industry is continuing exploration of new tuna fishing areas and is planning the construction of larger size boats (300 gross tons or more) for distant offshore fishing. Experiments are continuing with mothership operations, particularly in tropical waters. Future expansion of the industry, however, will depend mainly on the export trade in tuna and tuna products.

FORMOSA (TAIWAN)

Tuna fishing from Formosan ports has been carried on traditionally in the seas east of Formosa, principally for skipjack. During the Japanese control of Formosa, however, an important fishery for the black tuna was developed in the deeper waters between Formosa and the Philippine Islands. As boats became larger, operations were gradually extended to the South China, Sulu, and Celebes Seas, for yellowfin tuna primarily. During the 1930's operations became more intensive, and 14,764,680 pounds of tuna and tunalike fishes were landed at Formosan ports in 1936; one-third of the catch was skipjack, the remainder being black tuna, yellowfin tuna, and others. The postwar tuna fisheries have not changed appreciably. Production in 1948 was 15,121,890 pounds. Since Formosa is situated favorably for expanding its tuna fisheries, it can be expected that production will increase if vessels are available for offshore operations, and foreign markets can be developed for tuna products surplus to the needs of the local population. Most tunas, with the exception of skipjack, are consumed fresh by the local population; the skipjack is usually processed into katsuobushi, principally for export to Japan. Nothing is known about Formosan facilities for canning tuna.

PHILIPPINE ISLANDS

Tunas are among the most abundant of the marine resources in the waters surrounding the Philippine Islands. Of the 21 tuna and tunalike species found in these waters, the main species are the yellowfin, the skipjack, and the black tuna (closely allied to the luefin of the Pacific west coast). Tunas have been taken locally or centuries, but the catches by Filipinos have been small because essels are unable to operate in the offshore waters where the tunas re most plentiful.

Before World War II the Japanese extended their tuna fisheries southward, and obtained good catches in Philippine waters. Not only did vessels operate directly from Japan proper, Formosa, and the Ryukyu Islands, but the first Japanese-controlled land-based operation was established at Zamboanga in 1935. This Japanese-Philippine company, known as the Sea Foods Corporation, operated four fishing vessels, refrigerated storage, and a cannery. Canned tuna was prepared mainly for export to the United States. Table 24 shows the pre-World War II exports of canned tuna, the entire amount of which was believed prepared by the Zamboanga plant.

TABLE 24. - PHILIPPINES: EXPORT OF CANNED TUNA, 1935-1940

YEAR	TO THE UNITED STATES	TO OTHER COUNTRIES	TOTAL
	POUNDS	POUNDS	POUNDS
1935	167,580	0	167,580
1936	116,865	0	116,865
1937	138,915	0	138,915
1938	853,335	2,205	855,540
1939	1,122,345	0	1,122,345
1940	1,254,645	0	1,254,645

In 1936 a small Japanese tuna fishery was also established at Davao, primarily to catch skipjack for preparation into katsuobushi; similar plants were opened at Bangui and Aparri. These Japanese operations were neither extensive nor large, and vessels fished nearby waters. The plant at Zamboanga was destroyed during World War II; the other operations were also terminated by the departure of the Japanese at the end of the war. Apart from Japanese efforts, only one other attempt to establish a commercial fishery for tunas in the Philippines has been recorded. The Philippine Packing Corporation, which operated a fruit cannery, conducted exploratory fishing in 1934.

Post-World War II production of tuna by the Filipinos has been small. In 1946, 335,160 pounds were landed; in 1947 landings were 705,600 pounds. This tuna production was far below potential output.

Recent explorations, carried out by the Fish and Wildlife Service as part of the Philippine Rehabilitation Program, indicate that a tuna industry, employing as many as 10,000 people on vessels and inshore installations, could eventually be established in the Philippine Islands to supply local needs and to establish an export trade in canned tuna. Since American techniques are too expensive, fishing and canning methods best suited to local conditions must be developed. The development of a Philippine tuna industry would require capital for plant construction and for building vessels capable of fishing for skipjack and yellowfin, the two most abundant tuna species in Philippine waters (as shown by the Japanese pre-World War II operations).

INDONESIA

Indonesia's tuna fisheries are in an early developmental stage. Very little tuna is taken at present, but prewar Japanese fishing operations proved the existence of substantial stocks in several areas in the Indonesian Archipelago. A large tuna industry may help to relieve the adverse trade balance (currency drain) that has resulted from fish imports of over 44,000,000 pounds annually in recent years. The amount of imports is limited only by high prices, because Indonesia is believed capable of using over 2 billion pounds of fish, or three times the amount now consumed.

Present catches of tuna are composed primarily of skipjack; small amounts of yellowfin are also taken. Fishermen operate from March to December using hook and line with live bait. The fish are found at present within five hours' travel time from port. The catch is landed fresh, sold wholesale at public auction, and generally distributed smoked.

AUSTRALIA

Although Australia has a long coast line and an apparent abundance of tuna, its tuna fishing industry is little developed. Interest in tuna, however, has been growing since 1930. Initial packs of tuna have been made and trial shipments have been successfully marketed in the United States. The British Isles are reported to have contracted for canned tuna, and Australia itself is expected to eventually become a good canned tuna market.

The three major species of potential commercial importance are the skipjack, the southern bluefin (Thunnus maccoyii), and the northern bluefin (Kishinoella tonggol). A number of other tuna and tunalike fishes are found in Australian waters; among these are the yellowfin, the little tuna, and the bonito (Sarda australis).

Australia operated 17 fish canneries in 1952. Although these plants now pack only small amounts of tuna, the tuna resources are being looked on for future expansion of fish canning. In late 1950 a California-type tuna clipper began a five-months trial of live bait fishing possibilities in eastern Australian waters. This vessel caught 250,000 pounds of tuna in 70 days of active fishing.

NEW ZEALAND

The tunas are unimportant in New Zealand's fishing industry. Observations indicate that tunas are most abundant in the Tasman Sea and off the coast of northernmost New Zealand. Southern bluefin, yellowfin, albacore, and skipjack are known to frequent these areas, but the economic feasibility of a tuna industry in New Zealand has not been determined. The few tuna taken appear to be caught incidental to other fishing operations. In 1952, only 20 cases of tuna in oil were packed.

North America

MEXICO

Although tuna and tunalike fishes are found off both coasts of Mexico, only the Pacific supports a commercial industry. Two species, yellowfin and skipjack, are utilized. Operations are centered in the Gulf of California and along the Pacific shore of lower California. The productive waters immediately off this coast also provide a considerable part of the California tuna landings by United States vessels; much of this catch is shipped through Mexico into the United States under "via la pesca" permits.

The entire Mexican catch is canned. Approximate landings and the pack of canned tuna from 1940 to 1952, are shown in table 25.

Before 1947, Mexico exported canned tuna to the United States regularly. Exports to the United States from 1940 to November 30, 1952 are listed in table 26.

The entire Mexican tuna pack is now consumed domestically. Demand for tuna is said to exceed production. This demand and Mexico's

TABLE 25. - MEXICO: TUNA LANDINGS AND CANNED PACK, 1940-1952

YEAR	LANDINGS 1/	PACK OF CANNED TUNA
	POUNDS	POUNDS
1940	3,466,000	1,733,000
1941	882,000	441,000
1942	1,728,000	864,000
1943	2,892,000	1,446,000
1944	2,324,000	1,162,000
1945	2,160,000	1,080,000
1946	1,606,000	803,000
1947	780,000	390,000
1948	1,332,000	666,000
1949	1,584,000	792,000
1950	2,072,000	1,036,000
1951	1,636,000	818,000
1952	1,654,000	827,000

1/ calculated from canned weights

TABLE 26. - MEXICO: EXPORTS OF CANNED TUNA TO THE UNITED STATES, 1940-1952

YEAR	QUANTITY
	POUNDS
1940	410,777
1941	67,584
1942	142,675
1943	86,640
1944	116,610
1945	127,638
1946	44,394
1947	0
1948	0
1949	44
1950	44
1951	0
1952 (11 months)	0

proximity to fishing areas of proven production indicate that a great expansion of the country's tuna canning industry can be expected eventually.

CANADA

Possession of the world's second largest fish-canning industry and proximity to the world's best tuna market are major reasons for the existence of Canada's tuna industry. Distantly located from the more productive grounds, however, Canada has never developed large tuna fisheries; in 1948 only 0.2 percent of its fish catch was tuna. British Columbia has a small industry utilizing imported and locally caught albacore, and canning is done at plants normally used for salmon. Nova Scotia takes bluefin, but they are mostly exported fresh.

Canada's tuna catch has been large in some recent years, but landings are dependent on the occurrence of fish and the effort expended in the catch. Up to 1946 landings averaged about 600,000 pounds annually; since then they have been as shown in table 27.

TABLE 27. - CANADA: LANDINGS OF TUNA, 1946-1952

YEAR	BRITISH COLUMBIA	NOVA SCOTIA	TOTAL
	POUNDS	POUNDS	POUNDS
1946	431,600	1,820,700	2,252,300
1947	796,500	1,706,900	2,503,400
1948	2,175,000	781,300	2,956,300
1949	2,230,800	958,400	3,189,200
1950	2,114,300	787,400	2,901,700
1951	189,500	469,900	659,400
1952	(1)	655,400	(1)

(1) Not available.

Canada's tuna exports to the United States are limited almost entirely to fresh and frozen tuna, mostly from Nova Scotia. Canned tuna is usually consumed domestically or exported to other countries. Canadian tuna exports to the United States are shown in table 28.

British Columbia's salmon-canning industry easily converts to tuna canning during the off-season. Tuna is obtained from domestic landings by Canadian and sometimes United States vessels, or is imported from Japan and the United States when local sources fail as they did in 1950 and 1951. In 1950 three companies, representing a small segment of the fish-canning industry, were canning tuna in British Columbia. Nova Scotia cans a small amount of tuna incidentally to other species. Table 29 gives the production of canned tuna.

TABLE 28. - CANADA: TUNA EXPORTS TO THE UNITED STATES, 1947-1952

YEAR	FRESH OR FROZEN	CANNED	TOTAL
	POUNDS	POUNDS	POUNDS
1947	896,614	188,051	1,084,665
1948	220,343	7,546	227,889
1949	1,234,246	2	1,234,248
1950	891,312	280	891,592
1951	68,248	216	68,464
1952 1/	954,529	0	954,529

1/ Data for January through October.

TABLE 29. - CANADA: PRODUCTION OF CANNED TUNA, 1946-1952

YEAR	BRITISH COLUMBIA	NOVA SCOTIA	TOTAL
	CASES	CASES	CASES
1946	(1)	16,931	(1)
1947	(1)	19,184	(1)
1948	20,248	12,025	32,273
1949	15,254	8,536	23,790
1950	30,885	1,494	32,379
1951	53,280	7,562	60,842
1952	(1)	4,739	(1)

1/ Not available.
NOTE: Cases are reported on a basis of 48 - 7 ounce cans.

Only four or five Canadian vessels fish especially for tuna on the west coast and these must often go south to Oregon or California to find fish. When fish are available off British Columbia, halibut and salmon boats from Canada and the United States will enter the fishery. Nova Scotia tuna are taken mostly in trap nets and some by sport fishing.

Canada's tuna production is expected to increase slightly. As long as local landings and imports are available, the British Columbia salmon canneries can be expected to operate within the demand for tuna products. Tuna loins are being imported from Japan on an experimental basis in an attempt to reduce production costs. Nova Scotia's tuna production depends largely on the demand for fresh tuna by east oast United States packers. An increase in the Nova Scotia catch annot be expected with the present fishing methods. The Canadian overnment has made no special attempt to aid or develop the tuna industry.

CUBA

Although the Cuban fishing industry takes more than 450 species of edible fish from nearby waters, only a few are caught in large commercial quantities. Among these are the skipjack and the blackfin tuna (*Parathunnus atlanticus*). Both are taken by Cuban fishermen mainly from within territorial waters. Extensive explorations have not been conducted to determine how abundant these species are in offshore Cuban waters, but results of sport fishing indicate that these and other tunas occur in sufficient numbers to permit expansion of the Cuban tuna fisheries.

Total annual landings of fish and shellfish by Cuban fishermen have recently averaged about 25 to 30 million pounds. Detailed data on the tuna landings are not available, but have been estimated to be nearly 3,000,000 pounds of eviscerated fish in 1952.

Canning of tuna was first started in 1940 by the *Fabrica Nacional de Conservas*, and 1,777 cases of 48 7-ounce cans were produced in that year. A second plant, the *Mariscos del Carib*, began canning in 1944, and a third plant, the *Cia. Ganadera de La Habana*, began operations in 1945. Total production by the three plants in 1946 was 20,830 cases of 24 8-, 9-, or 9½-ounce cans. In 1952, five companies operating seven canneries, processed tuna as well as vegetables and other fishery products. Estimates of tuna production for 1952 were upward of 100,000 cases of 24 9½-ounce cans. Regardless of the species of tuna used or methods of packing, the cans are labeled "Bonito en Aceite" to compete with a similarly named product imported from Spain. It is estimated that 85 percent of the Cuban demand for canned tuna was satisfied by the local product.

Cuba has exported fresh or frozen tuna, but only in 1941 and in 1950 have the amounts exceeded more than 140,000 pounds annually. In 1941, 615,195 pounds were exported, almost entirely to the United States; in 1950, 566,685 pounds were exported, of which 361,620 pounds were sent to the United States.

Although Cuba is presently using only a small part of its available fishery resources, it is not expected that tuna production will increase sharply. Tunas are taken by small vessels as an off-season activity. These vessels are not suited to the mass production methods required for establishing large tuna fisheries.

Mediterranean

TURKEY

Fishing for tuna and tunalike fishes is conducted from many small and scattered ports along the coasts of Turkey. The most important tuna grounds, however, are located in the Dardanelles and the Bosporus and in the Sea of Marmara; the coastal area near Istanbul produces the largest catches. Various species make their seasonal migration from the Mediterranean en route to and from their spawning grounds in the Sea of Marmara or the Black Sea, thereby making it possible to obtain an abundance of fish with small fishing craft and comparatively simple gear. The most important tuna and tunalike species are the bluefin and the bonito, the latter being the mainstay of the fisheries. Other tunas are taken in small amounts. (NOTE: Turkish records and reports designate two species of bonito, the palamut and the bonitou or torik. These are actually one species, the former being the young fish and the latter the older ones.) The bonito is usually taken by fixed nets or traps, the bluefin by hook and line or harpoon from small vessels.

Accurate statistical records of fish production in Turkey have not been published. One estimate places the 1938 catch of tuna and tunalike fishes at about 132,000,000 pounds, or approximately half the total Turkish fish catch. About 80 percent of landings by tuna fishermen were bonito. Although this estimate appears to be high, its reliability is substantiated by the large exports in 1939. Recently, a sharp decline in the bonito catch, attributed to natural fluctuations in abundance, has occurred, but it is possible that overfishing or loss of foreign markets may also be responsible. The 1945 catch of tuna and tunalike fishes was estimated to be about 34,200,000 pounds.

In addition to being consumed by the Turkish people, the bonito is the most important fishery product exported. Small amounts of tuna are also exported. Table 30 shows the 1939 and 1947 exports of bonito.

TABLE 30. - TURKEY: EXPORTS OF BONITO BY COUNTRY OF DESTINATION, 1939 AND 1947

	1939		1947	
	FRESH	SALTED, CANNED SMOKED, OR DRIED	FRESH	SALTED, CANNED SMOKED, OR DRIED
	POUNDS	POUNDS	POUNDS	POUNDS
Italy	22,438,080	183,015	2,438,730	-
Greece	10,032,750	438,795	3,234,735	57,330
Bulgaria	4,365,900	4,410	507,150	207,270
Other	1,025,325	1,947,015	-	632,835
Total	37,862,055	2,573,235	6,180,615	897,435

Small amounts of bonito are canned by five canneries in the Istanbul area. A quality product is produced although the processing equipment is not modern. In 1948 the United Kingdom contracted with the canneries for 70,000 cases of canned bonito. Whether or not deliveries were made on this contract is not known. One freezing and cold-storage plant freezes bonito and tuna for shipment to Italy. Small amounts of bonito are salted, but the decline in the bonito catch has forced most salteries to close down.

ITALY

Tunas are taken along the coasts of Sardinia, Sicily, and the toe of the Italian boot. They are caught in huge fixed nets or traps (tonnare) as they migrate toward the Black Sea in the spring and return toward the Atlantic Ocean in the fall. Although tunas migrate into the Adriatic Sea, they frequent only the Yugoslav portion of that body of water. The catch is principally bluefin, which the Italians call tonno; next in importance are bonito, and skipjack. Virtually all of the catch is canned; Sicily is the center of the canning industry.

Landings of tuna in recent years have varied from a low of 2,500,000 pounds to a little over 6,000,000 pounds, as indicated in table 31.

The Italian people are heavy consumers of Italian-style canned tuna (heavily salted in olive oil). Demand is much greater than the domestic production, and Italy is second only to the United States among the world's tuna importers. Pre-World War II imports, principally from Turkey, Portugal, Spain, and Spanish Morocco, were important.

TABLE 31. - ITALY: LANDINGS OF TUNA AND TUNALIKE FISHES, 1939 AND 1946-1951

YEAR	LANDINGS 1/
	POUNDS
1939	3,647,070
1946	4,679,010
1947	4,791,465
1948	2,599,695
1949	5,131,035
1950	4,899,510
1951	6,376,860

1/ Landings of whole tuna (mostly bluefin tuna and tunalike fishes).

After the war Italy continued to be an excellent market for tuna, imported either canned or in the fresh or frozen form for canning locally. Beginning with 1951, Norway began to supply Italy with large quantities of frozen bluefin. Exports of canned tuna are small; they were 33,000 pounds in 1950 and 95,000 pounds in 1951, compared with 1939 shipments of over 1,000,000 pounds.

LIBYA

Before the war Italy obtained part of its tuna supply from its overseas colonies. Libya was then a small but important producer of tuna in the Mediterranean area. Because of Italian initiative, the Libyan tuna industry (nonexistent during Turkish rule) was able to land 2,734,200 pounds of tuna in 1936; 1,334,000 pounds of canned tuna in oil were exported almost exclusively to Italy. As a result of the North African conflict during World War II, the Libyan tuna industry suffered great losses in equipment and the country's separation from Italy brought about loss of its main market. By 1948, however, the industry was able to land 2,224,845 pounds of tuna. At the same time it recovered its former export market. In 1951, Libya exported 1,147,000 pounds of canned tuna in oil to Italy.

TUNISIA

Tunas are caught off the coast of Tunisia as they migrate eastward during the spring. They are taken in large fixed nets or with ook and line from small fishing boats. Landings have been small nd have declined sharply, as shown in table 32; the increased andings in 1950 were made principally by a new company (Societé es Madragues Tunisiennes), which was given monopoly rights in he tuna industry for 40 years:

TABLE 32. - TUNISIA: LANDINGS OF TUNA AND TUNALIKE FISHES, 1930-1937 AND 1944-1950

YEAR	POUNDS
1930	2,081,520
1931	2,079,315
1932	1,287,720
1933	1,082,655
1934	1,483,965
1935	740,880
1936	577,710
1937	1,658,160
1944	385,875
1945	557,865
1946	438,795
1947	253,575
1948	264,600
1949	143,325
1950	952,560

In 1950, half the catch was canned and exported. The possibility of increasing tuna production is regarded optimistically by Tunisian authorities, as tuna are reportedly plentiful and excellent locally produced olive oil is available for use in canning.

ALGERIA

In 1936, Algerian landings included 560,070 pounds of bluefin and 178,605 pounds of albacore; landings of these tunas in 1947 were 1,741,950 pounds. Tunas are caught in fixed traps and with hook and line. The main fishing centers in Algeria are Oran, Philippeville, and Bone.

WESTERN EUROPE

SPAIN

Tuna fishing is one of the oldest industries of Spain. Bluefin, albacore, and other tuna and tunalike fishes are caught in considerable numbers as they skirt the coasts of Spain and the Canary Islands during their migrations. Bluefin are taken mainly along the Spanish south coast en route to the Mediterranean Sea in the spring to spawn; lesser numbers are caught as the fish return to the ocean in the fall. Albacore are of equal importance, but are captured mainly along the north and northwest coasts. Bonito is also important, though less valuable, and several other species of small tunalike fish are taken in minor quantities. Also classified in Spanish statistics under bonito are skipjack and yellowtail.

Fishing along the south coast is mainly by large trap nets extending into the sea from coastal projections. Since 1928 trap operation has been under Consorcio Nacional Almadrabero, a monopoly owned 48 percent by the government. Major trap installations are at Tarifa, Barbata, and Sanctipetri (Cádiz Province) and near the Portuguese border (Province of Huelva). In the south and other areas tuna are also caught by trolling, shore seines, purse seines, and gill nets.

Recent recorded landings by Spain's tuna fishermen are given in table 33. The Canary Island catch is about one-tenth of the Spanish total.

Much of the tuna catch is marketed fresh or frozen; sizable quantities are salted, dried, or canned in oil. In 1945, when 64,170,000 pounds of the three principal species were caught, at least 7,074,000 pounds of canned tuna and 4,683,000 pounds of salted tuna were produced. During and after World War II, exports of canned tuna in oil varied from 2,000,000 to 7,837,000 pounds annually. Prewar canned tuna exports were much larger, 34,506,000 pounds being recorded for 1931. Italy and Switzerland were the principal markets in 1949, as shown by the export data for canned tuna in table 34.

The tuna canning industry in recent years has been handicapped by a shortage of tinplate owing to the small domestic tin production and to the limitations on foreign exchange for purchasing tin abroad. Relatively high production costs also are said to have placed Spanish canned tuna at a disadvantage on the world market.

TABLE 33. - SPAIN: LANDINGS OF TUNA AND TUNALIKE SPECIES, 1939-1952

YEAR	ALBACORE	BLUEFIN TUNA	BONITO	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS
1939	10,378,000	12,743,000	12,150,000	35,271,000
1940	13,953,000	20,405,000	11,750,000	46,108,000
1941	11,298,000	18,143,000	8,282,000	37,723,000
1942	17,373,000	14,941,000	10,531,000	42,845,000
1943	22,449,000	30,698,000	13,757,000	66,904,000
1944	25,360,000	24,833,000	13,023,000	63,216,000
1945	28,866,000	19,086,000	16,218,000	64,170,000
1946	21,172,000	23,067,000	15,733,000	59,972,000
1947	37,331,000	34,338,000	1,894,000	73,563,000
1948	32,242,000	22,328,000	606,000	55,176,000
1949	37,450,000	33,540,000	3,098,000	74,088,000
1950	40,810,000	18,906,000	28,586,000	88,302,000
1951	33,831,000	15,446,000	22,028,000	71,305,000
1952 1/	44,497,000	10,006,000	4,075,000	58,578,000

1/ January to October only.

TABLE 34. - SPAIN: EXPORTS OF CANNED TUNA AND TUNALIKE FISHES BY COUNTRY OF DESTINATION, 1949

COUNTRY	QUANTITY 1/
	POUNDS
Italy	2,116,380
Switzerland	1,309,515
Egypt	392,665
France	392,137
United States	135,388
Other countries	723,098
Total	5,069,183

1/ Includes small quantities of anchovies in oil.

Tuna fishing is also important in the Spanish Protectorates in northern Africa. Tunas are caught mainly in trap nets and by trolling, and much of the catch is canned. The 1947 landings of all tuna and tunalike fishes in the Protectorates were 2,426,000 pounds, and included 276,000 pounds of albacore, 1,916,000 pounds of bonito, and only 2,200 pounds of bluefin tuna. The 1933 catch of bluefin was reported to be 5,954,000 pounds, but the largest bluefin catch in recent years was 1,413,000 pounds in 1946.

Some of the tuna caught in the Spanish Protectorates reportedly is canned in small canning plants in Tangier. In 1933, 1,058,000 pounds of canned tuna was produced.

FRANCE

Tunas and tunalike fishes are caught along both the Atlantic and the Mediterranean coasts of France. On the Atlantic coast, where most of the tuna fishing is concentrated, bluefin and albacore are important. These species enter the coastal waters off southwest France during May, and migrate northward along Bretagne and Normandy. Tunas are also caught along these coasts during the southward migration in the fall.

Major Atlantic tuna fishing ports are Saint Jean de Luz, Douarnenez, Concarneau, Port Louis, Etel, Yeu, Les Sables-d'Olonne, and La Rochelle. Half of the fishing fleet operates from the Island of Groix. Fish are caught generally from small sailboats with hook and line. Recently, boats have been equipped with motor power and refrigeration; production has increased as the vessels have fished further offshore. The largest Atlantic tuna canneries are located in Camaret, Douarnenez, Audierne, Concarneau, Lorient, La Rochelle, and Saint Jean de Luz.

In the Mediterranean, relatively minor quantities of albacore, bluefin,and bonito are caught during the spring. Fixed nets are the most important gear for catching bluefin. The only French tuna cannery in the Mediterranean Area is at Sète.

In recent years tuna landings have varied from a low of less than 2,000,000 pounds in 1944 to an average of slightly more than 33,000,000 pounds for the years 1949-1951, as shown in table 35.

Most of the tuna catch is canned; little is consumed fresh or frozen. Tuna, canned in olive oil, is exported, but the quantities cannot be determined from available statistics. French export statistics show the total export of canned fish as salmon, sardines,

TABLE 35. - FRANCE: LANDINGS OF TUNA, 1930 - 1951

YEAR	ALBACORE	BLUEFIN	TOTAL 1/
	POUNDS	POUNDS	POUNDS
1930	13,622,490	3,327,345	16,949,835
1931	23,117,220	3,351,600	26,468,820
1932	17,115,210	2,487,240	19,602,450
1933	14,339,115	3,602,970	17,942,085
1934	21,161,385	5,986,575	27,147,960
1935	22,307,985	3,060,540	25,368,525
1936	19,359,900	4,132,170	23,492,070
1937	(2)	(2)	23,500,890
1938	20,885,760	5,389,020	26,274,780
1939	(2)	(2)	(2)
1940	(2)	(2)	16,541,910
1941	(2)	(2)	15,099,840
1942	(2)	(2)	15,494,535
1943	(2)	(2)	2,853,270
1944	(2)	(2)	1,695,645
1945	(2)	(2)	21,904,470
1946	(2)	(2)	14,109,795
1947	(2)	(2)	11,115,405
1948	(2)	(2)	17,079,570
1949	(2)	(2)	32,331,915
1950	(2)	(2)	34,495,020
1951 3/	(2)	(2)	33,075,000

1/ Does not include bonito.
2/ Not available.
3/ Estimated.

and "other fish." Tuna exports are included in the last group. Exports of "other fish" for 1949 amounted to nearly 44,000,000 pounds, of which 400,000 pounds were shipped to the United States.

PORTUGAL

(Including Azores, Cape Verde Islands, and Angola)

In Portugal, tuna fishing has long been an established industry. Bluefin are captured, particularly off South Portugal, while en route to spawning grounds in the Mediterranean Sea. Skipjack, bonito, and other tunalike fishes also are important. Large fixed traps are the major gear employed; trolling lines and various types of gill nets and seines are also used. The Portuguese tuna catch varied between 3,909,000 and 13,342,000 pounds annually from 1938 to 1951. Bluefin normally provide most of the catch, as indicated by the following data in table 36.

TABLE 36. - PORTUGAL: LANDINGS OF TUNA AND TUNALIKE FISHES, 1938-1951

YEAR	BLUEFIN	SKIPJACK	BONITO	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS
1938	5,716,000	853,000	154,000	6,723,000
1939	3,762,000	2,223,000	218,000	6,203,000
1940	4,156,000	1,162,000	190,000	5,508,000
1941	5,727,000	1,735,000	359,000	7,821,000
1942	6,498,000	1,967,000	833,000	9,298,000
1943	9,389,000	2,249,000	276,000	11,914,000
1944	8,922,000	1,224,000	972,000	11,118,000
1945	5,770,000	1,471,000	4,805,000	12,046,000
1946	10,538,000	1,360,000	1,444,000	13,342,000
1947	8,926,000	1,482,000	315,000	10,723,000
1948	5,484,000	1,124,000	104,000	6,712,000
1949	(1)	(1)	(1)	5,883,000
1950	(1)	(1)	(1)	3,909,000
1951	(1)	(1)	(1)	3,929,000

1/ Not available.

Most of the tuna catch is canned in oil or sauce and exported. Export data for recent years are given in table 37.

Italy has consistently received over half of the Portuguese tuna exports before and after World War II. A number of other countries have also provided well established markets. For several years prior to 1951, shipments to the United States were of fair size, but trade dropped to 9,000 pounds in 1951. Exports, by country of destination, are shown in table 38.

A reduction of the tuna catch since 1946, apparently caused by decline of the tuna resources, is of concern to Portuguese fishermen and the Portuguese Government. Portuguese tuna fishing recently has been limited to about three months a year, May to August, when tuna

BLE 37. - PORTUGAL: EXPORTS OF CANNED TUNA AND TUNALIKE FISHES, 1938-1951

AR	IN BRINE	IN OIL OR SAUCE	TOTAL
	POUNDS	POUNDS	POUNDS
38	291,000	2,600,000	2,891,000
39	322,000	1,316,000	1,638,000
40	46,000	3,519,000	3,565,000
41	168,000	3,965,000	4,133,000
42	289,000	2,891,000	3,180,000
43	84,000	3,790,000	3,874,000
44	2,000	3,376,000	3,378,000
945	0	4,719,000	4,719,000
946	15,000	2,994,000	3,009,000
947	137,000	1,603,000	1,740,000
948	20,000	5,429,000	5,449,000
949	68,000	3,713,000	3,781,000
950	9,000	3,680,000	3,689,000
951	26,000	3,570,000	3,596,000

ABLE 38. - PORTUGAL: EXPORTS OF CANNED TUNA AND TUNALIKE FISHES BY COUNTRY OF DESTINATION,1947-1951

OUNTRY	1947	1948	1949	1950	1951
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
taly	260,000	4,015,000	2,741,000	2,414,000	2,964,000
razil	49,000	68,000	0	35,000	205,000
witzerland......	161,000	245,000	340,000	284,000	68,000
elgium-Luxembourg	362,000	300,000	24,000	121,000	66,000
ortuguese colonies	26,000	51,000	62,000	55,000	64,000
nited States....	516,000	340,000	174,000	523,000	9,000
ll other countries	366,000	430,000	440,000	257,000	220,000
Total	1,740,000	5,449,000	3,781,000	3,689,000	3,596,000

re caught mostly in the trap nets off the cost of Algave. The use of ore powerful fishing craft and modern fishing methods is contemplated, owever, and these are expected to make possible a year-round supply f tuna, of which a major portion would be of the white-meat variety cceptable on the American market. Changing world conditions are making the Portuguese Government look more keemly towards the American arket.

To increase the tuna catch, two American submarine chasers have been purchased recently. These vessels are equipped with two 900 horse power motors and have refrigeration compartments for 100,000 pounds of fish each. One of these vessels has already completed a successful trial run and both are expected to leave soon for tuna fishing with lines in the waters off the Canary Islands.

Portugal possesses very large colonies in Africa (Angola and Mozambique), as well as the Azores and the Madeira Islands. All are located near actual and potential tuna fishing grounds. In the Azores the tuna industry has been increasing production since 1929; five large and six small canneries are operated principally on Sao Miguel and Tereira Islands. These canneries operate 60 motor launches and a number of small boats, and at peak production employ 2,500 persons in fishing and canning. The main fish used for canning is bluefin, although bonito is also canned in smaller quantities. Normal Azores production is estimated at 3,300,000 pounds per year; in 1949, 2,200,000 pounds were canned and shipped to the United States, Italy, France, Switzerland, Belgium, and Brazil.

Tuna fisheries are also conducted in the Cape Verde Islands. Production is small, the pack in 1947 being about 600,000 pounds.

Oceanic conditions off Angola are similar to those off Peru and large tuna resources are available. In a recent visit to Angola, a Fish and Wildlife Service observer noted quantities of yellowfin widely distributed along the coast. A growing tuna canning industry is centered around the port of Mossamedes. Presently, fishing is one of the most important single industries of Angola. Recent annual landings of all fish have been between 100,000,000 and 250,000,000 pounds. Tuna landings in 1950 were reported to have been about 2,600,000 pounds. Recently, fish canning has increased owing to the demand for canned fish in Italy.

Northern Europe

NORWAY, SWEDEN, AND DENMARK

Although the Scandinavian countries are not located near the world's principal tuna grounds, bluefin frequent nearby waters. This fish has been taken in the Sound, the Kattegat, the Skagerak, the North Sea, and the Norwegian Sea. The gradual warming of North Atlantic waters during the last several decades has resulted in the ppearance of the bluefin in larger numbers farther northward, and ince 1947 larger tuna landings have been made, especially by Norway rom waters north of Bergen. Before World War II the combined landngs from Norway, Sweden, and Denmark did not exceed 1,800,000 pounds nnually. Since 1947 catches have been as indicated in Table 39.

ABLE 39. - SCANDINAVIA: LANDINGS OF TUNA, 1947-1952

EAR	NORWAY POUNDS	DENMARK POUNDS	SWEDEN POUNDS	TOTAL POUNDS
947	463,050	864,360	220,500	1,547,910
948	811,440	1,047,375	282,240	2,141,055
949	5,651,415	4,476,150	1,225,980	11,353,545
950	3,774,960	2,185,155	207,270	6,167,385
951	11,545,380	2,723,175	(1)	(1)
952	25,172,280	(1)	(1)	(1)

/ Not available.

Norway's landings would have been larger during 1952 if additionl freezing, canning, and transport facilities had been available. nly 330,750 pounds of fresh fish can be sent daily by rail from ergen, and during the height of the tuna season the daily landings eached 1,984,500 pounds. Since tuna landings more than doubled in 952, freezing, storing, and canning facilities were inadequate for andling the increased landings.

The Norwegians were able, however, to can about 10 percent of heir catch. Besides shipping 1,300 pounds of canned tuna to Venezula, 500 railroad cars of frozen tuna were sent to Sicily for canning n Italian style. The Norwegian canned tuna has a darker color, oarser texture, and stronger flavor than the product preferred by he American customer. These qualities, however, make the product uitable for the Italian trade. If Italy remains a good market for luefin, the Norwegian tuna fishery can expand when the necessary andling and distribution facilities are provided.

Denmark and Sweden do not have special tuna fisheries. Part of enmark's catch is canned for domestic consumption. Presumably the ajority of Sweden's catch is also consumed domestically.

South America

PERU

Peru occupies a central position in the tuna fisheries of Latin America's west coast. Its geographical location near the richest part of the Humboldt current has enabled the country to develop not only a sizable tuna industry, but to maintain its leadership among the tuna producers of Latin America.

The Pacific Ocean along the Peruvian coast is known for its rich marine life, ocean currents bringing highly mineralized water from the ocean depths to the surface. These nutrient-rich waters are the basis for a food chain which culminates in the occurrence of large and valuable food fishes, such as bonito, yellowfin, and skipjack. An important link in the food chain is the anchovy (Engraulis ringeus) since it constitutes the main food for the various tunas.

The bonito, found throughout the area in which the coastal current flows, generally follows the migration of the anchovy. In winter the anchovy is spread over a wide area but during spring and summer it is found close inshore, since the warm oceanic waters force it into the narrow band of cold water along the coast. At this time landings of bonito are largest. The yellowfin and the commercially less important skipjack migrate from the open sea into coastal water. These tunas are found more frequently along the northern and southern Peruvian coasts than along the central part.

Before the 1940 decade the Peruvian tuna fisheries were poorly developed and lacked adequate vessels, gear, skilled fishermen, ports, and processing facilities. Expansion was stimulated in 1942 by UNRAA's request for additional production (75 percent tuna in brine and 25 percent canned tuna in oil) to supply European war areas with much needed animal protein food. The fishing industry was only partially able to meet UNRAA's demands, since it still lacked refrigeration plants, canning plants, tinplate, and oil.

Despite these early limitations, production of tuna and tuna-like fishes increased steadily and by 1951 was over 131,000,000 pounds. Domestic consumption of tuna products also increased. Most of the bonito consumed locally is in the fresh state; about 10 to 12 percent of the total production of canned bonito is also absorbed in the domestic market. Increased landings were made possible mainly by private companies who introduced motor-driven launches outfitted with modern gear, such as purse seines for tuna and gill or drift nets for bonito. Tuna and tunalike fish landings by Peruvian fishermen are shown in table 40.

TABLE 40. - PERU: LANDINGS OF TUNA AND TUNALIKE FISHES, 1939-1952

YEAR	YELLOWFIN	SKIPJACK	BONITO	TOTAL
	POUNDS	POUNDS	POUNDS	POUNDS
1939	40,572	66,811	1,185,629	1,293,012
1940	220,941	86,656	2,985,129	3,292,726
1941	1,614,501	79,821	3,551,373	5,245,695
1942	157,216	22,932	12,608,411	12,788,559
1943	805,928	22,932	26,387,235	27,216,095
1944	32,634	24,916	36,000,594	36,058,144
1945	650,034	62,402	41,247,755	41,960,191
1946	3,004,313	56,448	32,537,421	35,598,182
1947	4,001,414	149,719	35,355,411	39,506,544
1948	6,553,260	928,305	44,033,850	51,515,415
1949	7,313,985	3,023,055	59,722,425	70,059,465
1950	30,325,365	963,585	69,025,320	100,314,270
1951	16,314,795	2,910,600	111,945,645	131,171,040
1952 1/	4,815,720	4,972,275	68,765,130	78,553,125

1/ January to June inclusive.

Tuna landings by Peruvian fishermen have been disposed of fresh, frozen, or canned in oil or brine, as shown by the latest available data in table 41.

The export of tuna, at first principally to Italy, increased steadily until 1946. It is claimed that tuna played an important role in relieving famine conditions in certain parts of Europe toward the end and immediately after World War II. When UNRRA discontinued further purchases of relief supplies in 1947, Peru had already established other markets for its canned tuna. The bulk was shipped to the United States; such European countries as Belgium, Luxembourg, Italy, and Switzerland imported smaller but significant amounts. Exports from Peru continued to increase but in 1951 showed a slight drop. Table 42 gives details about the Peruvian exports of canned tuna.

TABLE 41. - PERU: DISPOSITION OF TUNA AND TUNALIKE FISH LANDINGS, 1950 - 1951

PRODUCT	1950	1951 1/
	POUNDS	POUNDS
FRESH OR FROZEN:		
YELLOWFIN................	24,119,172	15,279,989
SKIPJACK	-	822,024
BONITO..................	23,254,151	22,050,000
TOTAL..........	47,373,323	38,152,013
	CASES 2/	CASES 2/
CANNED IN OIL:		
YELLOWFIN................	84,251	48,505
SKIPJACK	34,362	16,424
BONITO..................	502,139	402,958
TOTAL..........	620,752	467,887
	CASES 3/	CASES 3/
CANNED IN BRINE:		
YELLOWFIN................	1,896	12,078
SKIPJACK................	-	-
BONITO..................	34,945	34,568
TOTAL..........	36,841	46,646

1/ January to October.
2/ Cases represent 48 7-ounce cans per case.
3/ Cases represent 48 1-pound cans per case.

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TABLE 42. - PERU: EXPORTS OF CANNED TUNA AND TUNALIKE FISHES BY COUNTRY OF DESTINATION, 1950 - 1951

	1950		1951 - 1/	
COUNTRY	IN OIL	IN BRINE	IN OIL	IN BRINE
	CASES	CASES	CASES	CASES
UNITED STATES.......	496,989	(2)	332,700	(2)
BELGIUM............	11,334	(2)	-	(2)
ITALY..............	13,034	(2)	-	(2)
SWITZERLAND.........	34,001	(2)	-	(2)
OTHERS.............	11,334	(2)	84,187	(2)
TOTAL....	566,692	34,841	416,887	44,546

1/ January to October. (2) Not available.
NOTE: Cases represent 48 7-ounce cans.

In 1948, Peru started to export small quantities of frozen tuna; by 1950, this trade had reached considerable proportions. Virtually all frozen tuna has been shipped to the United States and has consisted almost exclusively of yellowfin, as shown in table 43.

TABLE 43. - PERU: EXPORTS OF FROZEN TUNA AND BONITO, 1948-1952

SPECIES	1948	1949	1950	1951	1952 1/
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
YELLOWFIN	(2)	(2)	14,378,805	14,637,672	4,681,215
SKIPJACK	(2)	(2)	-	767,561	3,733,065
BONITO	(2)	(2)	-	9,482	-
TOTAL	644,963	2,156,490	14,378,805	15,414,715	8,414,280

1/ January to June
2/ Not available

The main ports used by the Peruvian tuna industry are Callao, Ilo, Paita, and Chinbote. The first cannery was established in 1939, and 45 plants were in operation in 1952. Freezing plants, with a daily freezing capacity of 800,000 pounds, were in use in 1951. Cold-storage capacity was 14,000,000 pounds. In 1952 the fishing fleet engaged in catching tuna consisted of 1,000 vessels operated by about 6,000 fishermen.

The Peruvian Government has snown some interest in developing the tuna industry, although it has done little to improve the lot of the fishermen by education or by providing modern equipment. It has established a Fisheries Technology Laboratory in Callao to develop and test processing methods.

CHILE

Chile's utilization of fish is limited and until 1942 the tuna catch was extremely small and of importance only for local consumption. The white meat albacore was considered the fare of the poorest people in the northern ports of Chile. When Americans visiting Chile showed a high regard for the albacore, the fish became an expensive dish in the best hotels.

The main species of tuna found in Chilean waters are yellowfin, albacore, and skipjack. Bonito, at first taken in moderate quantities compared with the tunas, has recently become more important. It is consumed locally fresh or canned, but is exported only in the canned form. No commercial organization is devoted solely to the catching and canning of tuna, nor are any Chilean boats equipped to fish for tuna exclusively.

Before 1945, Chilean landings of tuna and tunalike fishes averaged between 1,000,000 and 3,000,000 pounds annually. In 1945 they reached a total of 5,867,505 pounds. Thereafter, production was moderate until 1949, when landings exceeded 10,000,000 pounds. Table 44 gives the landings made by Chilean fishermen.

TABLE 44. - CHILE: LANDINGS OF TUNA AND TUNALIKE FISHES, 1938-1951

YEAR	TUNA POUNDS	BONITO POUNDS	TOTAL POUNDS
1938	(1)	(1)	2,306,430
1939	(1)	1,320,795	1,320,795
1940	643,860	174,195	818,055
1941	1,095,885	1,036,350	2,132,235
1942	189,630	815,850	1,005,480
1943	2,465,190	646,065	3,111,255
1944	1,786,050	240,345	2,026,395
1945	4,562,145	1,305,360	5,867,505
1946	2,024,190	901,845	2,926,035
1947	1,053,990	3,702,195	4,756,185
1948	(1)	(1)	(1)
1949	1,001,070	9,371,250	10,372,320
1950	908,460	6,454,035	7,362,495
1951	1,534,680	8,760,465	10,295,145

1/ Not available.

The freezing and canning of tuna products has been limited. With the exception of the tuna canned or frozen, practically all tuna and tunalike fishes are consumed fresh at the local ports. Little is sold elsewhere in Chile except in the canned form.

Chile is a fairly good consumer of canned tuna. At least 11 canneries reportedly pack tuna and bonito but none pack these products exclusively. A large canning plant at Iquique is said to be the only modern and complete fish freezing and canning establishment in Chile.

Despite the increased landings, there appears to be little effort made to increase tuna exports. Chilean exports of canned tuna have been moderate, as shown in table 45.

TABLE 45. - CHILE: EXPORTS OF CANNED TUNA AND TUNALIKE FISHES, 1942-1950

YEAR	TO UNITED STATES	TO OTHER COUNTRIES	TOTAL
	POUNDS	POUNDS	POUNDS
1942	(1)	130,095	130,095
1943	308,700	304,290	612,990
1944	714,420	271,215	985,635
1945	1,719,900	183,015	1,902,915
1946	950,355	68,355	1,018,710
1947	222,705	41,895	264,600
1948	127,890	13,230	141,120
1949	185,220	467,460	652,680
1950	716,625	57,330	773,955

1/ Insignificant.

The export of frozen tuna was begun in 1950, when 68,355 pounds were shipped to the United States. Between January and September of 1951, 99,225 pounds were exported, also to the United States. This trade has been limited because adequate freezing facilities are lacking. Only the plant at Iquique is equipped to prepare frozen tuna for export.

To improve the diet of the people and to obtain foreign exchange by increasing exports, the Chilean Corporación de Fomento de la Producción has shown an interest in better utilization of Chile's fishery resources. Originally, the Corporación planned to increase exports of canned tuna to 500,000 cases (about 12,000,000 pounds) of white-meat tuna to the United States. Plans for the rapid expansion of the fishing industry have not materialized because capital and experience are lacking. Canning plants do not employ modern machinery, and cans are not standardized and are of inferior quality. Labor is poorly paid but production costs are high, owing to the use of antiquated machinery and inefficient production methods.

ECUADOR

Although the waters around the Galapagos Islands and near Ecuador's much indented 500-mile coast line contain abundant quantities of tuna, the country's fishing industry is small and unorganized. Along the coast the temperatures are oppressive and most fishing is done at night. Fishing vessels are small dugouts, propelled by sails, and only one or two Diesel-powered vessels are available for fishing offshore waters. Local fishing is done on a small scale with hook and line, the catch being sufficient only to satisfy the needs of the fishermen and other coastal people. About a thousand people are employed in the fishing industry.

Statistical data are not available to indicate the amount of tuna and tunalike fishes caught. Fresh or dried and salted albacore and bonito are sold in Guayaquil and other coastal towns. Despite Ecuador's proven tuna resources, the country is a net importer of processed fishery products, mainly from Peru and the United States.

Because of the successful tuna fisheries conducted by the United States vessels in Galapagos waters and the progress made by Peru in its tuna fisheries and tuna export trade, Ecuador's leading government and business organizations have become more conscious of the country's tuna resources. A desire exists for the establishment of a local tuna industry, but prospects for such development are not promising. Fresh water is lacking for the operation of canning and freezing plants, trained fishermen and skilled labor are not available, and a labor law is in existence which tends to increase production costs without increasing the productivity per person. Attempts made in the past to establish fish-canning plants in Ecuador have all failed.

COLUMBIA

Because Colombia's small fishing fleet is handicapped by lack of equipment and small operating range, the country's tuna resources have never been utilized or assessed. However, extensive tuna resources probably exist in waters off both the Caribbean and the

Pacific coasts. As far as known, purse seining has never been tried, and the poor keeping quality of local bait fishes has discouraged fishing off Colombia by foreign tuna clippers.

Colombia has two small plants which prepare canned fish and other products. One plant, belonging to the *Empacadora del Prado*, is at Barranquilla; the other, owned and operated by the *Empacadora Santa Marta*, is at Santa Marta. Mullet and sardines are usually canned; when bonito is available it is packed in vegetable oil.

In recent years interest has been shown in developing Colombia's fisheries, but so far, developments have been confined to Caribbean-based inshore operations for supplying fresh fish to Colombia's largest communities.

VENEZUELA

The fisheries of Venezuela have undergone considerable expansion during recent years, but so far only a few tuna have been taken incidentally during inshore trolling operations. Venezuela has been more interested in developing local production of relatively low-priced fishery products for domestic consumption, and an extensive sardine canning industry has been established. Although fishing vessels and techniques have been improved, the fisheries have not been expanded to offshore waters where supplies of tuna are said to be abundant.

BRAZIL

Although Brazil has a large potential domestic market for fish and fishery products, its fisheries are little developed and of small economic importance. Commercial fishermen and fishery experts agree that a wealth of marine resources exist off the Brazilian coast. Little, however, has been done to explore these valuable resources; meanwhile, large quantities of fish, both canned and salted, are imported.

Statistical data indicate that tuna and tunalike fishes comprise no more than a small part of the total fish catch. Large schools of tuna, however, have been reported along the northern Brazilian coast, these schools being especially numerous near the small island of Fernando de Noronha, 225 miles east of the hump of Brazil. Albacore and bonito are listed as the principal varieties. A scientific booklet, published by the Hunting and Fishing Division of the Brazilian Ministry of Agriculture, states that these species are particularly suitable for smoking.

Although tuna has been reported as abundant off the northern coast of Brazil, most fish processing plants are located in the south, principally in the States of Rio de Janeiro, Rio Grande do Sul, and Sao Paulo. Of the 120 establishments registered, 45 are devoted to canning and 75 to salting. Probably little or no tuna is processed.

Central America

COSTA RICA

Large quantities of tuna, mostly yellowfin and skipjack, occur in Pacific waters off Costa Rica. Tuna fisheries could be operated on a large scale from Costa Rican bases by native fishermen, but there seems to be little interest in expanding present activities. About 250 Costa Ricans are employed on American tuna boats. Other Costa Rican fishermen number less than 100; these fishermen operate from Puntarenas with about 10 powered vessels and 50 small canoes and sailboats.

The port of Puntarenas with its sheltered harbor, ship stores, and marine ways and machine shops, is a natural center for fishing activity. In 1936 a freezing plant was established at the port with United States capital and machinery; this plant -- one of the largest in Central America -- is presently leased to a California tuna-processing company. Freezing operations, begun in 1937 on a small scale, attained an output of 7,285,320 pounds in 1938. Subsequent output has varied considerably, but reached its peak in 1950 with 9,891,630 pounds. The tuna handled by this plant has been brought in mainly by United States vessels, and after being frozen was shipped to the United States.

In 1942 a small California-type cannery was established at Puntarenas and operated in connection with the freezing plant. The cannery's maximum capacity is said to be 100,000 cases per year, and the pack is reported to be of excellent quality. Some is consumed in Costa Rica; the bulk, however, is exported principally to Latin-American countries.

Statistics of tuna landings in Costa Rica are not available. Moreover, because of the small but significant local consumption, available export statistics only reflect the size of landings by United States vessels. Exports of tuna products are shown in table 46.

TABLE 46. - COSTA RICA: EXPORTS OF TUNA AND TUNALIKE FISHES, 1937-1951

YEAR	FRESH OR FROZEN	CANNED IN OIL	TOTAL
	POUNDS	POUNDS	POUNDS
1937	277,830	-	277,830
1938	7,285,320	-	7,285,320
1939	7,481,565	-	7,481,565
1940	4,211,550	-	4,211,550
1941	1,845,585	-	1,845,585
1942	2,350,530	17,640	2,368,170
1943	994,455	44,100	1,038,555
1944	1,905,120	22,050	1,927,170
1945	1,435,455	498,330	1,933,785
1946	2,824,605	707,805	3,532,410
1947	3,867,570	3,212,685	7,080,255
1948	6,339,375	198,450	6,537,825
1949	4,551,120	149,940	4,701,060
1950	9,891,630	141,120	10,032,750
1951	3,007,620	19,845	3,027,465

In April 1949, at the request of the International Bank for Reconstruction and Development, the Food and Agriculture Organization of the United Nations undertook a study of possibilities for fishery development in Costa Rica. Because of the ready market for tuna in the United States, it was concluded that Costa Rica could obtain valuable foreign exchange if some of the tuna now caught in Costa Rica or adjoining waters by United States vessels could be taken and landed by Costa Rican fishermen. It was proposed that five American-type refrigerated purse seiners, of 70 to 80 tons cargo capacity, be acquired. The establishment of additional freezing and cold-storage facilities in Puntarenas was also suggested. Since canned tuna is protected by a United States import duty, it was not considered advisable to establish new canning facilities or to enlarge the plant already in operation.

Costa Rica is a logical base for both United States and Costa Rican vessels, and possible development of larger shore facilities (shops and freezing plants) may eventually make it the center of the tuna industry in the eastern Pacific. During the past few years United States tuna clippers have tended to base more and more of their activities at Puntarenas during the peak January to June fishing season off Costa Rica.

EL SALVADOR

El Salvador, the smallest and most densely populated of the Central American republics, has a Pacific coast line exposed to the full sweep of the Pacific oceanic currents. At times vast schools of tuna and tunalike fishes are seen migrating not too far from shore. These and other pelagic species occur in greatest abundance from June to September; during this time the fishermen of El Salvador land a considerable quantity of fish for personal use and for the local market. No detailed statistics are available to ascertain how much are tuna, and no export statistics are given from which deductions could be made.

The possibilities for tuna production in El Salvador are limited because of the short coast line, the seasonal occurrence of fish, the lack of trained fishermen, and the lack of efficient boats and gear. Four cold-storage plants are located in El Salvador; these plants are capable of handling limited quantities of tuna for local consumption.

GUATEMALA

Very little is known about the fish resources of Guatemala. Along its Pacific coast schools of tuna are common 30 or more miles from shore; close inshore their occurrence is sporadic. Suitable harbors for basing a fishing fleet, refrigeration or processing plants, and seaworthy boats, such as the tuna industry requires, do not exist along Guatemala's west coast.

The Caribbean coast of Guatemala offers more favorable fishing conditions and better harbor protection than the Pacific coast. Tuna occur infrequently, however, and little opportunity for developing a tuna industry exists.

NICARAGUA

Nicaragua, the largest of the Central American republics, has
coast line of about 200 miles on the Pacific and 300 miles on
e Caribbean. The waters off both coasts contain sizable fishery
sources, particularly those off the Pacific coast. The lack of
pulation and the poor transportation facilities, however, make
e commercial utilization of these resources extremely difficult.
nsequently, Nicaragua has an exceedingly small tuna fishing in-
stry. There are no known exports of tuna, and the few tuna
ught by native fishermen are consumed locally. The government
s made no effort to develop a domestic fishing industry or to
tablish Nicaraguan bases for foreign fishing fleets.

HONDURAS

Commercial fishing is not conducted in Honduras, except for
ne operations of one small company engaged in providing fish for
ne Tegucigalpa market. It is known that tunas migrate along the
oast of Hunduras, but they are rarely seen on the market. Refrig-
ration or canning plants do not exist, and the government shows
o interest in the development of a fishing industry.

PANAMA

Panama has neither a tuna fishing fleet nor tuna processing
stablishments. Its only interest in the tuna fisheries is the
ees obtained by issuing bait-fishing licences to California tuna
lippers. In 1951, fees received amounted to $73,000. Exports of
una or tunalike fishes from Panama to the United States are re-
orted, but these are predominantly transshipments of fish caught
y American boats. In 1950, Panama reported tuna imports of
1,895 pounds, valued at $16,000. As far as known, no Panamanian
lans exist for the development of a tuna fishing fleet nor for
he establishment of shore plants.

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CHAPTER IV -- DOMESTIC PRODUCTION

ABSTRACT

OF THE 32 PERCENT OF WORLD PRODUCTION OF TUNA AND TUNALIKE FISHES ACCOUNTED FOR BY UNITED STATES FISHERMEN, ALMOST ALL OF THIS AMOUNT IS TAKEN ON THE PACIFIC COAST. NEARLY ALL TUNA CLIPPERS AND ABOUT 15 PURSE SEINERS ARE USED SOLELY TO FISH FOR TUNA AND RELATED SPECIES. OTHER CRAFT ENGAGED IN THE TUNA FISHERY ARE ALSO OPERATED TO A LARGE EXTENT IN OTHER FISHERIES SUCH AS THOSE FOR SALMON, HALIBUT, BOTTOM FISHES, PILCHARDS, ETC.

SUPPLYING MECHANICAL EQUIPMENT TO THE TUNA FLEET IS A HIGHLY COMPETITIVE FIELD INVOLVING OUTSTANDING FIRMS WITH HIGHLY TRAINED ENGINEERING STAFFS. THE ALMOST UNIVERSALLY-USED SLOW SPEED HEAVY DUTY MAIN DIESEL ENGINES ARE EXTREMELY RELIABLE AND ECONOMICAL. REPLACEMENT OF THESE WITH HIGH SPEED DIESELS WOULD RESULT IN A REDUCTION OF WEIGHT AND A SAVINGS IN CARGO SPACE, BUT RE-TRAINING OF ENGINEERS WOULD BE REQUIRED AND LOWER DEPENDABILITY MIGHT RESULT. SMALLER TUNA VESSELS HAVING PROPORTIONATELY INCREASED CARGO SPACE THROUGH THE USE OF HIGH SPEED DIESELS MIGHT RESULT IN MORE ECONOMICAL OPERATIONS. DIESEL-ELECTRIC PROPULSION WOULD PROVIDE GREATER FLEXIBILITY AND LOWERED MAINTENANCE COSTS, BUT THE INITIAL COST MIGHT BE DOUBLE THAT OF THE PRESENT ENGINES.

THERE APPEARS TO BE LITTLE PROSPECT OF IMPROVEMENT IN CONVENTIONAL PROPELLERS. THE DESIGN OF TUNA VESSELS CAN BE IMPROVED ONLY AT THE COST OF DECREASED CARRYING CAPACITY AND EFFICIENCY. PRIMARY FAULT OF THE AMMONIA COMPRESSION REFRIGERATION SYSTEM, NEARLY UNIVERSAL IN THE TUNA FLEET, MAY BE LACK OF ADEQUATE RESERVE CAPACITY. THE AMMONIA ABSORPTION SYSTEM HAS CERTAIN ADVANTAGES, BUT TRIALS TO DATE HAVE NOT BEEN ENTIRELY SUCCESSFUL DUE TO IMPERFECTIONS IN THE SYSTEM AND LACK OF TRAINED ENGINEERS. HYDRAULIC PUMPS AND PLASTIC PIPING OFFER POSSIBILITIES FOR LOWER INSTALLATION AND MAINTENANCE COSTS.

RADAR, LORAN, AND DEPTH SOUNDERS HAVE MATERIALLY INCREASED FISH PRODUCTION SINCE WORLD WAR II. DEVELOPMENT OF NEW ELECTRONIC DEVICES SUCH AS ECHO-RANGING UNITS AND UNDERWATER LISTENING EQUIPMENT HOLD PROMISE OF GREATLY INCREASING EFFICIENCY OF FISHING OPERATIONS. ELECTRICAL FISHING EXPERIMENTS CONDUCTED IN EUROPE ON MARINE FISHES INDICATE THAT THE SUCCESSFUL DEVELOPMENT OF ELECTRICAL FISHING EQUIPMENT COULD REVOLUTIONIZE SOME METHODS OF COMMERCIAL FISHING.. PRESENT FISHING GEAR IS EFFECTIVE AND ANY CHANGE MUST PROVE OF DECIDED SUPERIORITY. PLASTIC OR NYLON NETTING MIGHT PROVE SUPERIOR TO COTTON AND LINEN FOR PURSE SEINES. GILL NETS CAN CATCH TUNA AND MAY BE USED AS AUXILIARY GEAR. IF AMERICAN FISHERMEN CAN PROFITABLY USE LONG-LINE GEAR, NEW FISHING AREAS IN THE EAST-CENTRAL PACIFIC MAY BE OPENED UP.

THE PRESENT TUNA BOATS ARE HIGHLY EFFICIENT AS OPERATED. UNLESS SOME REVOLUTIONARY MEANS OF CATCHING TUNA IS DEVELOPED TO A PRACTICAL STAGE THERE APPEARS TO BE LITTLE CHANCE OF CURTAILING PRODUCTION COSTS THROUGH INCREASED EFFECTIVENESS PER UNIT OF CREW EFFORT.

BAIT IS AN IMPORTANT ASPECT OF THE UNITED STATES TUNA FISHERY, SINCE 70 PERCENT OF THE TOTAL CATCH OF TUNA BY UNITED STATES VESSELS IS MADE WITH BAIT. IN 1950 ROUGHLY 1 POUND OF BAIT WAS NECESSARY TO TAKE 10 POUNDS OF SKIPJACK OR YELLOWFIN TUNA, AND A LESSER AMOUNT FOR ALBACORE. AN ESTIMATED 26,000,000 POUNDS

OF BAIT (FOREIGN AND DOMESTIC) WAS USED BY THE BAIT BOAT FLEET IN 1950. ABOUT 17 PERCENT OF A TUNA-BAIT BOAT'S TIME AT SEA IS SPENT IN SECURING BAIT. BETWEEN 85 AND 90 PERCENT OF THE BAIT SUPPLY IS FOUND IN FOREIGN COUNTRIES. SOME OF THESE COUNTRIES PERMIT BAITING BY AMERICAN VESSELS WITH VARYING RESTRICTIONS. A LIMITED AMOUNT OF RESEARCH CONCERNING SYNTHETIC BAIT HAS BEEN STARTED. DEVELOPMENT OF A SUITABLE SYNTHETIC BAIT OR A SUBSTITUTE SOURCE OF NATURAL BAIT WOULD BENEFIT THE TUNA FISHERY.

A LIMITED NUMBER OF TUNA VESSELS MIGHT BE PROFITABLY EMPLOYED IN OTHER FISHERIES. HOWEVER, A LARGE INFLUX OF NEW VESSELS WILL HAVE A SOMEWHAT DELETERIOUS EFFECT ON ANY ONE FISHERY. DURING THE 1952 SALMON SEASON, SIX OF THE 17 FREEZER-SHIPS WORKING IN BRISTOL BAY WERE TUNA CLIPPERS. THESE TUNA BOATS WERE HANDICAPPED BY THEIR INABILITY TO CARRY A SUFFICIENT NUMBER OF CATCHER BOATS AND THEY RECEIVED ONLY PARTIAL LOADS.

SOME OF THE SMALLER VESSELS IN THE TUNA FLEET MIGHT PROVE SUCCESSFUL IN THE SHRIMP FISHERY AS CATCHER BOATS AND REFRIGERATED TRANSPORTS WORKING THE MORE DISTANT GROUNDS. THE USE OF LARGER REFRIGERATED TUNA VESSELS IN THE SHRIMP INDUSTRY OF THE SOUTH ATLANTIC AND GULF STATES IS IMPRACTICAL.

TUNA BOATS SHOULD NOT ENTER THE PACIFIC COAST TRAWL FISHERY BECAUSE THE MARKET FOR TRAWL FISH IS AMPLY SERVED BY THE PRESENT TRAWL FLEET. POTENTIALITIES IN THE TRAWL FISHERY ARE UNATTRACTIVE, SINCE THE VALUE OF ITS LANDINGS AMOUNT TO ONLY SEVEN PERCENT OF THE VALUE OF THE TUNA FISHERY.

THE POSSIBILITIES OF PROFITABLY OPERATING TUNA VESSELS IN THE TRANSPORT TRADE ARE VERY DIM. COMPARED TO A REEFER SHIP ON A TONNAGE BASIS, A TUNA CLIPPER WOULD PAY ABOUT 5 TIMES THE WAGES PER TON CAPACITY AND 3.5 TIMES THE OPERATING COST PER TON CAPACITY.

BOTH THE TUNA CLIPPER AND THE LARGE SEINER ARE READILY ADAPTABLE AS INDEPENDENT, LONG-LINE CATCHER BOATS AND THE CLIPPER MIGHT PERFORM SOME SORT OF MOTHERSHIP DUTY TO SMALLER PURSE SEINERS, OR TO OTHER TYPES OF SMALLER FISHING VESSELS.

OF THE VARIOUS LOCATIONS FROM WHICH THE DOMESTIC TUNA FLEET MIGHT OPERATE -- OTHER THAN THE BASES NOW USED -- THE EQUATORIAL CENTRAL PACIFIC AREA AND THE GULF-CARIBBEAN AREA HOLD PROMISE FOR FUTURE DEVELOPMENT AS AN EXPANSION OF, BUT NOT A SUBSTITUTE FOR, THE PRESENT FISHING GROUNDS OF THE UNITED STATES TUNA FLEET. THE UNITED STATES SOUTH ATLANTIC AND GULF OF MEXICO PORTS AND THE PORTS OF PUERTO RICO AND THE VIRGIN ISLANDS HAVE CONDITIONS ATTRACTIVE TO THE DEVELOPMENT OF NEW TUNA PROCESSING PLANTS AND VESSEL BASES. BUT IT IS DOUBTFUL THAT THE SAVINGS IN ANY LARGE-SCALE MOVEMENT WOULD OFFSET THE DISADVANTAGES. THE OUTLOOK FOR FAVORABLE CHANGES IN LOCATION OF THE ENTIRE TUNA FISHING FLEET IN THE PACIFIC IS SIMILARLY POOR.

DEVELOPMENT AND/OR EXPANSION OF THE UNITED STATES TUNA INDUSTRY IS POSSIBLE IN 3 AREAS NOT NOW FISHED ON A LARGE-SCALE BY THE DOMESTIC INDUSTRY. THESE AREAS ARE THE ATLANTIC COAST, THE GULF OF MEXICO AND CARIBBEAN AREA, AND THE EASTERN CENTRAL PACIFIC. RECENTLY-GAINED KNOWLEDGE INDICATES THAT LARGE STOCKS OF SEVERAL SPECIES OF TUNA, AS YET ONLY PARTIALLY OR WHOLLY UNEXPLOITED, INHABIT THESE WATERS WITHIN RANGE OF AMERICAN PORTS. THE RATE OF DEVELOPMENT OF THESE RESOURCES IS DIFFICULT TO PREDICT BECAUSE VERY LITTLE IS KNOWN AT THE PRESENT CONCERNING THE HABITS AND ACTUAL ABUNDANCE OF THE SPECIES, AND THE INDUSTRIAL EXPANSION WILL BE DEPENDENT TO A LARGE DEGREE ON THE ECONOMIC CONDITION OF THE TUNA MARKET IN COMING YEARS.

BLUEFIN HAVE BEEN CAUGHT BY COMMERCIAL FISHERMEN IN NEW ENGLAND WATERS DURING THE SUMMER AND EARLY FALL FOR THE PAST HALF CENTURY OR MORE. ANNUAL PRODUCTION IS SMALL COMPARED TO THE PACIFIC COAST TUNA FISHERY, NORMALLY RANGING IN RECENT YEARS BETWEEN 1 AND 2 MILLION POUNDS WITH MOST OF THE CATCH COMING FROM TRAPS IN CAPE COD BAY. EFFORTS TO PURSE SEINE BLUEFIN IN THE GULF OF MAINE BY COMMERCIAL FISHERMEN IMMEDIATELY PRIOR TO WORLD WAR II AND BY THE FISH AND WILDLIFE SERVICE IN 1951 RESULTED IN GOOD CATCHES, BUT A LOW AND UNSTEADY LOCAL MARKET FOR TUNA DISCOURAGED COMMERCIAL DEVELOPMENT. SINCE THE WAR, TUNA-CANNING ACTIVITIES HAVE INCREASED ON THE ATLANTIC COAST, WITH 5 CANNERIES IN OPERATION IN 1952. THE SEASONAL OCCURRENCE OF LARGE SCHOOLS OF BLUEFIN IN INSHORE WATERS INDICATES THAT THE FISHERY MAY POSSIBLY BE EXPANDED FURTHER OFFSHORE, BUT THE OFFSHORE POTENTIAL IS UNKNOWN NOW. ADEQUATE PORT FACILITIES, THE PRESENCE OF LARGE AMOUNTS OF LIVE BAIT, AND A FLEET OF FISHING VESSELS WHICH COULD BE READILY ADAPTED TO LONG-LINE FISHING ARE FACTORS IN FAVOR OF EXPANSION OF ATLANTIC COAST TUNA FISHING. IN ADDITION TO THE BLUEFIN, LITTLE TUNA AND BONITO ARE PRESENT IN CONSIDERABLE BUT UNKNOWN QUANTITIES FROM CAPE COD TO FLORIDA.

STOCKS OF TUNA ON WHICH TO BASE A GULF AND CARIBBEAN TUNA FISHERY ARE KNOWN TO EXIST. DEVELOPMENT BY UNITED STATES FISHERMEN IS LIKELY WHEN AND IF OUR KNOWLEDGE OF SEASONAL OCCURRENCE AND ADAPTATIONS OF FISHING METHODS TO THE LOCAL CONDITIONS IS SUFFICIENT. A LIMITED FISHERY FOR LITTLE TUNA IN THE GULF IS NOW POSSIBLE IF MARKETING PROBLEMS CAN BE SOLVED. EXTENSIVE SCHOOLS OF TUNA WERE OBSERVED IN THE CENTRAL GULF IN 1951 AND 1952 BY THE FISH AND WILDLIFE SERVICE EXPLORATORY RESEARCH VESSEL OREGON. THE EXISTENCE OF A SUCCESSFUL LIVE-BAIT FISHERY FOR TUNA IN CUBA LENDS ENCOURAGEMENT TO THE POSSIBILITY OF EXPLOITING CARIBBEAN TUNA WITH LONG-RANGE VESSELS CAPABLE OF FOLLOWING THE SEASONAL MIGRATIONS OF THE FISH.

RICH NEW TUNA FISHING GROUNDS WERE RECENTLY DISCOVERED BY THE SERVICE'S PACIFIC OCEANIC FISHERY INVESTIGATIONS IN EQUATORIAL MID-PACIFIC WATERS SOUTH OF HAWAII. EXCELLENT LONG-LINE CATCHES HAVE BEEN MADE OVER A WIDE AREA, INDICATING THAT CONSIDERABLE EXPANSION OF KNOWN PRODUCING GROUNDS IS POSSIBLE. THE MAJORITY OF THE TUNA CATCH IS MADE UP OF LARGE YELLOWFIN, WITH SOME SKIPJACK AND BIG-EYED TUNA. AMERICAN TUNA SEINERS AND LARGE CLIPPERS ARE READILY ADAPTABLE TO LONG-LINE FISHING, AND, ON THE BASIS OF EXPERIMENTAL CATCHES, AN AMERICAN VESSEL AND CREW OF 12 MIGHT EXCEPT AN AVERAGE DAILY CATCH OF FROM 6,000 TO 13,000 POUNDS IN THE MOST PRODUCTIVE AREAS. THERE IS A POSSIBILITY OF LIMITED EXPLOITATION OF SURFACE TUNA IN THE LINE AND PHOENIX ISLANDS. ADDITIONAL SHORE-SIDE FACILITIES ARE NEEDED FOR ANY USE OF THESE ISLANDS AS TUNA FLEET BASES.

MOST OF THE ACTUAL TUNA FISHING BY UNITED STATES VESSELS TAKES PLACE ON THE HIGH SEAS BEYOND THE LIMITS OF CLAIMED TERRITORIAL SEAS. HOWEVER, THE TUNA FLEET REGULARLY ENTERS FOREIGN TERRITORIAL WATERS TO CAPTURE BAIT, TO UTILIZE PORT FACILITIES, AND TO FISH FOR TUNA IN SOME LOCATIONS. FOR THESE REASONS, AMERICAN TUNA FISHERMEN PURCHASE LICENSES AND OBSERVE FISHING REGULATIONS OF THESE COUNTRIES. ALBACORE BOATS, PURSE SEINERS, AND TUNA CLIPPERS ARE AFFECTED IN VARYING DEGREES BY THE FOREIGN CLAIMS AND REGULATIONS. SOME 200 TUNA CLIPPERS, WORKING FROM SOUTHERN CALIFORNIA TO INTERNATIONAL WATERS OFF NORTHERN PERU, ARE TOTALLY DEPENDENT ON LIVE BAIT AND ARE MOST AFFECTED BY THE LIMITATIONS OF TERRITORIAL WATERS. CLAIMS TO TERRITORIAL SEAS MADE BY LATIN AMERICAN COUNTRIES RANGE FROM 3 TO 200 MILES OFFSHORE, ALTHOUGH ALL ARE NOT ENFORCED. TUNA BAIT USUALLY IS TAKEN WITHIN 3 MILES OFF SHORE SO THESE COUNTRIES EXERT COMPLETE CONTROL OVER THESE BAIT RESOURCES.

RELATIONS BETWEEN THE AMERICAN TUNA FLEET AND THE LATIN AMERICAN COUNTRIES HAVE BEEN GOOD CONSIDERING THE LARGE NUMBER OF BOATS INVOLVED. SEIZURES OF AMERICAN VESSELS HAVE FOLLOWED INCREASED TERRITORIAL WATER CLAIMS AND CHANGES IN FISHING REGULATIONS. ALTHOUGH THE UNITED STATES RECOGNIZES ONLY THE 3-MILE LIMIT, SOME COUNTRIES ARE ENFORCING CLAIMS UP TO 12 MILES. AMERICAN FISHERMEN HAVE OBSERVED SUCH CLAIMS FOR PURPOSES OF EXPEDIENCY, NOT BECAUSE THEY RECOGNIZE THEM AS VALID.

THE ABILITY OF LATIN AMERICAN COUNTRIES TO DEVELOP LOCAL TUNA INDUSTRIES WILL UNDOUBTEDLY PLAY A MAJOR ROLE IN FUTURE FISHERY LEGISLATION. THERE ARE POSSIBLE ALTERNATE SOURCES OF BAIT, BUT THEY ENTAIL INCONVENIENCE AND INCREASED COSTS AT THIS TIME. PRESENT RESEARCH TO DEVELOP ARTIFICIAL OR ALTERNATE TUNA BAITS IS PROMISING, AND COULD RELIEVE THE TUNA FLEET FROM ITS ALMOST TOTAL DEPENDENCE ON FOREIGN SUPPLIES. RESULTS OF RECENT EXPLORATION INDICATE THAT THERE ARE SUFFICIENT STOCKS OF TUNA IN THE HIGH SEAS BEYOND ALL TERRITORIAL JURISDICTIONS TO SUPPORT THE PRESENT INDUSTRY IF SOME OF THE EXISTING FISHING GROUNDS WERE CLOSED.

QUANTITY AND VALUE OF PRODUCTION

It has been shown that the United States accounted for about 32 percent of world production of tuna and tunalike fishes in 1951. That harvest was taken almost entirely by Pacific Coast States fishermen. A complete statistical survey of the catch of tuna and tunalike fishes was made throughout the United States in 1950. The results of this survey with respect to the quantity of the catch, together with estimates of the quantity of the catch for 1951 and 1952, are shown in table 47. This table shows the preponderance of the Pacific Coast States catch in the total of tuna and tunalike fishes produced in the United States.

The fact that the preponderant part of the United States catch of tuna and tunalike fishes has been made by Pacific Coast States fishermen has been the case historically for many years. Although complete statistical surveys of the United States catch of tuna and tunalike fishes were made in 1945, 1940 and a number of prior years, these surveys do not give the total catch of these fish exactly. In those years small quantities of certain tuna and tunalike species caught on the Atlantic and Gulf Coasts were reported under other fish names since the identification of those fish was not clear. However, the particular fish which were not identified properly, principally little tuna and bonito, make up the smaller part of the Atlantic and Gulf Coast catch. Bluefin is the largest item in the total of that catch. Complete data for the catch of bluefin in the Atlantic Coast States are available for a number of years and are shown in table 48. From this table it may be observed that in all years, from 1929 through 1950, the Atlantic coast bluefin catch, which makes up the bulk of the Atlantic and Gulf Coast States catch of tuna, was small compared to the tuna catch of the Pacific Coast States which is shown by species in table 49 for the years 1911 through 1950.

TABLE 47.- UNITED STATES CATCH OF TUNA AND TUNALIKE FISHES, 1950 - 1952

(EXPRESSED IN THOUSANDS OF POUNDS)

SPECIES	PACIFIC COAST STATES		
	1950	1951	1952 1/
	QUANTITY	QUANTITY	QUANTITY
A:			
LBACORE	72,415	34,491	2/
LUEFIN	2,762	3,862	2/
ITTLE	-	-	2/
KIPJACK	126,786	116,599	2/
ELLOWFIN	187,889	161,481	2/
TOTAL	389,852	316,433	328,000
ALIKE FISHES;			
ONITO	696	777	2,374
ELLOWTAIL	3,530	4,670	9,212
TOTAL	4,226	5,447	11,586
GRAND TOTAL	394,078	321,880	339,586

SPECIES	ATLANTIC AND GULF COAST STATES		
	1950	1951 1/	1952 1/
	QUANTITY	QUANTITY	QUANTITY
A:			
LBACORE	- -	-	2/
LUEFIN	1,267	1,800	2/
ITTLE	296	300	2/
KIPJACK	-	-	2/
ELLOWTAIL	-	-	2/
TOTAL	1,563	2,100	800
ALIKE FISHES:			
ONITO	124	125	125
TOTAL	124	125	125
GRAND TOTAL	1,687	2,225	925

SPECIES	TOTAL		
	1950	1951 1/	1952 1/
	QUANTITY	QUANTITY	QUANTITY
A:			
LBACORE	72,415	34,491	2/
LUEFIN	4,029	5,662	2/
ITTLE	296	300	2/
KIPJACK	126,786	116,599	2/
ELLOWFIN	187,890	161,481	2/
TOTAL	391,416	318,533	328,800
ALIKE FISHES:			
ONITO	820	902	2,499
ELLOWTAIL	3,530	4,670	9,212
TOTAL	4,350	5,572	11,711
GRAND TOTAL	395,766	324,105	340,511

ESTIMATED. 2/ NOT AVAILABLE.

Table 48. - ATLANTIC COAST STATES: BLUEFIN TUNA CATCH, 1929 - 1952

YEAR	NEW ENGLAND STATES		MIDDLE ATLANTIC STATES		CHESAPEAKE BAY STATES		TOTAL	
	POUNDS	VALUE	POUNDS	VALUE	POUNDS	VALUE	POUNDS	VALUE
1929	222,027	$19,086	113,604	$8,313	-	-	335,631	$27,399
1930	239,264	14,483	57,162	4,774	-	-	296,426	19,257
1931	301,223	20,559	20,150	833	-	-	321,373	21,392
1932	255,626	11,561	59,468	2,616	-	-	1/315,094	14,177
1933	401,481	17,569	43,228	1,926	-	-	444,709	19,495
1934	(2)	(2)	(2)	(2)	-	-	(2)	(2)
1935	538,500	13,931	24,100	1,143	-	-	562,600	15,074
1936	(2)	(2)	(2)	(2)	100	$1	(2)	(2)
1937	928,800	31,575	94,100	3,966	100	8	1,023,000	35,549
1938	1,567,400	58,126	255,600	9,952	-	-	1,823,000	68,078
1939	834,900	30,103	114,500	4,724	-	-	949,400	34,827
1940	1,120,900	39,229	33,900	1,312	-	-	1,154,800	40,541
1941	(2)	(2)	(2)	(2)	-	-	(2)	(2)
1942	771,600	69,678	51,100	5,062	4,000	483	826,700	75,223
1943	382,800	48,224	93,500	17,052	(2)	(2)	476,300	65,276
1944	754,100	106,262	75,000	9,205	-	-	829,100	115,467
1945	1,226,200	216,653	148,100	24,415	-	-	1,374,300	241,068
1946	1,007,800	67,308	176,600	27,338	-	-	1,184,400	94,646
1947	945,200	88,506	141,200	25,361	1,100	132	1,087,500	113,999
1948	2,878,100	194,999	119,200	18,520	-	-	2,997,300	213,519
1949	2,673,900	196,457	64,200	11,152	-	-	2,738,100	207,609
1950	1,135,100	96,321	132,100	16,045	-	-	1,267,200	112,366
1951	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
1952	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)

1/ DOES NOT INCLUDE 3,350 POUNDS, VALUED AT $134 LANDED IN FLORIDA.
2/ DATA NOT AVAILABLE.

Table 49. - PACIFIC COAST STATES: TUNA CATCH BY SPECIES, 1911 - 1952

(EXPRESSED IN THOUSANDS OF POUNDS AND THOUSANDS OF DOLLARS)

YEAR	ALBACORE		BLUEFIN		SKIPJACK	
	QUANTITY	VALUE	QUANTITY	VALUE	QUANTITY	VALUE
1911	850	5	-	-	-	-
1912	3,400	20	-	-	-	-
1913	6,600	53	-	-	-	-
1914	18,470	222	-	-	-	-
1915	21,050	316	-	-	-	-
1916	4,100	78	1/20,540	1/700	(2)	(2)
1917	30,170	1,207	1,150	25	420	11
1918	7,270	400	6,240	218	3,020	91
1919	13,630	845	17,180	687	6,900	241
1920	18,880	1,982	15,780	740	7,960	378
1921	15,280	1,222	3,420	85	1,140	25
1922	13,230	1,151	3,500	132	11,860	270
1923	12,515	1,627	3,645	182	11,463	298
1924	17,695	1,829	3,726	345	3,781	179
1925	22,207	2,333	4,190	377	14,235	752
1926	2.351	220	6,787	360	20,951	873

(CONTINUED ON NEXT PAGE)

Table 49. - PACIFIC COAST STATES: TUNA CATCH BY SPECIES, 1911 - 1952 - Continued

(EXP (EXPRESSED IN THOUSANDS OF POUNDS AND THOUSANDS OF DOLLARS)

YEAR	ALBACORE		BLUEFIN		SKIPJACK	
	QUANTITY	VALUE	QUANTITY	VALUE	QUANTITY	VALUE
1927	4,579	517	4,898	312	33,807	1,261
1928	283	42	13,701	823	15,815	562
1929	269	40	7,527	490	26,998	1,081
1930	286	24	21,921	1,238	20,486	790
1931	37	3	3,534	169	16,507	504
1932	620	31	1,071	51	21,637	751
1933	2	(3)	560	29	16,687	613
1934	121	9	18,358	846	14,830	594
1935	2,448	200	25,173	1,145	17,197	688
1936	984	91	18,925	922	26,992	1,191
1937	3,520	287	12,694	725	47,104	2,319
1938	17,726	966	17,728	983	22,654	1,133
1939	18,922	1,009	11,836	602	30,121	1,300
1940	14,502	996	19,970	1,117	56,650	2,743
1941	11,932	1,712	9,519	581	25,586	1,362
1942	23,540	4,566	12,845	1,159	38,735	3,335
1943	37,518	6,104	10,178	967	28,894	2,583
1944	52,795	8,666	20,344	1,939	30,037	2,694
1945	39,483	7,697	20,594	1,984	33,348	2,982
1946	24,142	4,784	22,032	2,246	41,088	4,283
1947	26,844	6,780	20,838	3,321	52,749	7,628
1948	4/49,493	14,659	6,529	1,096	60,554	9,534
1949	54,794	10,039	4,389	713	80,512	11,923
1950	72,415	13,835	2,762	425	126,786	18,130
1951	34,491	5,403	3,862	604	116,599	16,655
1952	(5)	(5)	(5)	(5)	(5)	(5)

YEAR	YELLOWFIN		TOTAL	
	QUANTITY	VALUE	QUANTITY	VALUE
1911	-	-	850	5
1912	-	-	3,400	20
1913	-	-	6,600	53
1914	-	-	18,470	222
1915	-	-	21,050	316
1916	(2)	(2)	24,640	778
1917	-	-	31,740	1,243
1918	-	-	16,530	709
1919	615	27	38,325	1,800
1920	2,200	105	44,820	3,205
1921	1,400	35	21,240	1,367
1922	7,360	294	35,950	1,847
1923	11,072	1,218	38,695	3,325
1924	3,125	500	28,327	2,853
1925	13,279	2,151	53,911	5,613
1926	12,565	591	42,654	2,044
1927	25,934	1,304	69,218	3,394
1928	32,251	1,774	62,050	3,201
1929	37,399	2,200	72,193	3,811
1930	56,654	3,396	99,347	5,448
1931	36,580	1,979	56,658	2,655
1932	36,923	1,505	60,251	2,338
1933	51,076	2,275	68,325	2,917
1934	60,913	3,053	94,222	4,502
1935	72,252	3,620	117,070	5,653
1936	78,353	4,139	125,254	6,343
1937	91,523	5,458	154,841	8,789
1938	78,318	4,705	136,426	7,787
1939	110,418	5,912	171,297	8,823
1940	113,760	6,707	204,882	11,563
1941	76,702	4,851	123,739	8,506
1942	41,467	3,836	116,587	12,896
1943	49,262	4,881	125,852	14,535
1944	63,144	6,269	166,320	19,568
1945	87,448	8,718	180,873	21,381
1946	127,247	14,614	214,509	25,927
1947	153,510	23,919	253,941	41,648
1948	199,427	33,406	316,003	58,695
1949	190,544	30,999	330,239	53,674
1950	187,889	28,823	389,852	61,213
1951	161,481	24,961	316,433	47,623
1952	(5)	(5)	6/328,000	(5)

1/ INCLUDES SKIPJACK AND YELLOWFIN.
2/ INCLUDED WITH BLUEFIN.
3/ LESS THAN 500 DOLLARS.
4/ INCLUDES 132,000 POUNDS, VALUED AT $32,000 LANDED IN ALASKA.
5/ DATA NOT AVAILABLE.
6/ PARTLY ESTIMATED.

NOTE:--DATA FOR 1911-1926 FROM UNITED STATES, TARIFF COMMISSION REPORT TO THE UNITED STATES SENATE ON TUNA FISH, REPORT NO. 109, SECOND SERIES. JANUARY 3, 1936.

Table 50. - PACIFIC COAST STATES: BONITO AND YELLOWTAIL CATCH, 1916 - 1952

(EXPRESSED IN THOUSANDS OF POUNDS AND THOUSANDS OF DOLLARS)

YEAR	BONITO		YELLOWTAIL		TOTAL	
	QUANTITY	VALUE	QUANTITY	VALUE	QUANTITY	VALUE
1915	448	13	1,343	31	1,791	44
1916	480	(1)	1,153	(1)	1,633	(1)
1917	889	(1)	2,746	(1)	3,635	(1)
1918	2,442	(1)	11,515	(1)	13,957	(1)
1919	3,509	(1)	5,005	(1)	8,514	(1)
1920	874	(1)	2,705	(1)	3,579	(1)
1921	325	(1)	2,491	(1)	2,816	(1)
1922	958	(1)	3,414	(1)	4,372	(1)
1923	1,115	(1)	3,980	(1)	5,095	(1)
1924	1,038	29	4,714	375	5,752	404
1925	867	26	3,180	272	4,047	298
1926	3,079	93	5,023	266	8,102	359
1927	1,717	50	4,225	195	5,942	245
1928	2,088	68	2,684	139	4,772	207
1929	2,919	98	3,075	150	5,994	248
1930	5,164	167	4,770	210	9,934	377
1931	3,080	49	2,526	84	5,606	133
1932	2,862	53	1,796	51	4,658	104
1933	2,252	40	3,899	88	6,151	128
1934	3,203	77	2,347	79	5,550	156
1935	7,896	229	8,149	234	16,045	463
1936	7,216	221	10,092	299	17,308	520
1937	7,808	286	5,371	212	13,179	498
1938	7,753	286	6,812	253	14,565	539
1939	9,919	321	2,866	96	12,785	417
1940	5,291	196	5,957	203	11,248	399
1941	10,827	459	9,831	383	20,658	842
1942	1,651	115	2,726	193	4,377	308
1943	2,282	182	4,935	369	7,217	551
1944	816	69	2,955	234	3,771	303
1945	2,714	217	3,534	292	6,248	509
1946	5,626	536	4,562	374	10,188	910
1947	13,697	1,606	9,953	1,124	23,650	2,730
1948	9,135	1,062	10,446	1,163	19,581	2,225
1949	1,830	178	7,320	686	9,150	864
1950	696	68	3,530	314	4,226	382
1951	777	74	4,670	443	5,447	517
1952	2,374	(1)	9,212	(1)	11,586	(1)

1/ DATA NOT AVAILABLE.
NOTE:--DATA FOR 1916 - 1922 FROM CALIFORNIA BUREAU OF MARINE FISHERIES, FISH BULLETIN NO. 74.

The catch of bonito and yellowtail -- the tunalike fishes -- for the Pacific Coast States is shown in table 50 by species for the years 1915 through 1950. Values of the catch are also given in these last three tables. As a result of detailed statistical surveys, value data are available for the Pacific Coast States tuna and tunalike species catch for most years. However, 1950 is the only year when complete value data were recorded for the entire United States as a result of the detailed statistical survey conducted in that year. The value of the catch along with the quantity caught in 1950 for the entire United States is shown in table 51.

In order to show by general areas where most of the domestic catch is taken, tables 52, 53, and 54, have been prepared. In recent years most of our catch has been taken off Latin America. The smaller proportion of the total catch has been taken off the Pacific Coast States and in one year, 1948, 132,000 pounds of albacore were taken off Alaska. Operating range of the domestic tuna fleet is shown in figure 14.

TABLE 51. - UNITED STATES: CATCH OF TUNA AND TUNALIKE FISHES, 1950

(Expressed in thousands of pounds and thousands of dollars)

Species	Pacific Coast States	
	Quantity	Value
Tuna:		
Albacore	72,415	13,835
Bluefin	2,762	425
Little	-	-
Skipjack	126,786	18,130
Yellowfin	187,889	28,823
Total	389,852	61,213
Tunalike fishes:		
Bonito	696	68
Yellowtail	3,530	314
Total	4,226	382
Grand total	394,078	61,595

(Continued on next page)

TABLE 51. - UNITED STATES: CATCH OF TUNA AND TUNALIKE FISHES, 1950 (continued)

(Expressed in thousands of pounds and thousands of dollars)

SPECIES	ATLANTIC AND GULF COAST STATES		TOTAL	
	Quantity	Value	Quantity	Value
TUNA:				
Albacore........	-	-	72,415	13,835
Bluefin.........	1,267	112	4,029	537
Little	296	11	296	11
Skipjack........	-	-	126,786	18,130
Yellowfin.......	-	-	187,889	28,823
Total	1,563	123	391,415	61,336
TUNALIKE FISHES:				
Bonito..........	124	10	820	78
Yellowtail......	-	-	3,530	314
Total	124	10	4,350	392
Grand Total	1,687	133	395,765	61,728

TYPES OF TUNA FISHING NOW EMPLOYED

Pacific Coast States

Three general types or methods of fishing are now employed by American fishermen in the tuna fisheries of the Eastern Pacific Ocean contiguous to the North and South American continents and outlying islands and offshore banks. Generally these methods are also commonly associated with three specific types of fishing craft. The three types are as follows:

1. Purse seine nets operated by "seiners" or purse seine vessels.
2. Bait lines, also referred to as bait fishing or live bait fishing. The craft are termed "bait boats" or "live bait boats". Larger vessels of this type with raised-deck and clipper bow are more generally termed "clippers" or "tuna clippers".

ble 52. - PACIFIC COAST STATES: TUNA CATCH BY AREA OF CAPTURE, 1911 - 1952

ALBACORE		BLUEFIN		SKIPJACK	
OFF PACIFIC COAST STATES	OFF LATIN AMERICAN COUNTRIES	OFF PACIFIC COAST STATES	OFF LATIN AMERICAN COUNTRIES	OFF PACIFIC COAST STATES	OFF LATIN AMERICAN COUNTRIES
QUANTITY	QUANTITY	QUANTITY	QUANTITY	QUANTITY	QUANTITY
850	-	-	-	-	-
3,400	-	-	-	-	-
6,600	-	-	-	-	-
18,470	-	-	-	-	-
21,050	-	-	-	-	-
4,100	-	1/20,540	-	(1)	-
30,170	-	1,150	-	420	-
7,268	2	6,240	-	3,020	-
13,550	80	17,180	-	6,885	15
18,880	-	15,780	-	7,942	18
15,278	2	3,360	60	1,140	(2)
13,230	-	3,473	27	10,115	1,745
12,488	27	3,562	83	4,579	6,884
17,280	415	3,726	-	1,356	2,425
21,685	522	4,190	-	8,768	5,467
2,351	(2)	6,787	-	14,217	6,734
4,455	124	4,898	(2)	5,804	28,003
283	-	13,701	-	4,263	11,552
269	(2)	7,477	50	8,032	18,966
286	-	15,599	6,322	3,015	17,471
37	-	2,358	1,176	11,966	4,541
620	-	460	611	375	21,262
2	-	324	236	(2)	16,687
121	-	18,292	66	-	14,830
2,387	61	18,496	6,677	1,908	15,239
984	-	13,809	5,116	8,457	18,535
3,520	-	10,822	1,872	1,884	45,220
17,696	30	16,512	1,216	3	22,651
18,918	4	9,319	2,517	2,719	27,402
14,501	1	18,850	1,120	2,985	53,665
11,932	-	8,848	671	4,215	21,371
20,916	2,624	10,332	2,513	218	38,517
28,019	9,499	7,664	2,514	18	28,876
43,020	9,775	16,084	4,260	4	30,033
27,221	12,262	14,139	6,455	93	33,255
15,180	8,962	15,529	6,503	1,747	39,341
21,082	5,762	14,756	6,082	893	51,856
3/23,567	25,926	1,694	4,835	319	60,235
31,217	23,577	2,266	2,123	27	80,485
48,839	23,576	9	2,753	12	126,774
16,869	17,622	3,025	837	1	116,598
(4)	(4)	(4)	(4)	(4)	(4)

YELLOWFIN		TOTAL		
OFF PACIFIC COAST STATES	OFF LATIN AMERICAN COUNTRIES	OFF PACIFIC COAST STATES	OFF LATIN AMERICAN COUNTRIES	TOTAL
QUANTITY	QUANTITY	QUANTITY	QUANTITY	QUANTITY
-	-	850	-	850
-	-	3,400	-	3,400
-	-	6,600	-	6,600
-	-	18,470	-	18,470
-	-	21,050	-	21,050
(1)	-	24,640	-	24,640
-	-	31,740	-	31,740
-	-	16,528	2	16,530
615	-	38,230	95	38,325
1,700	500	44,302	518	44,820
1,350	50	21,128	112	21,240

FOOTNOTES AT END OF TABLE.

(CONTINUED ON NEXT PAGE)

Table 52. - PACIFIC COAST STATES: TUNA CATCH BY AREA OF CAPTURE, 1911 - 1952 - Continued

YEAR	YELLOWFIN		TOTAL		
	OFF PACIFIC COAST STATES	OFF LATIN AMERICAN COUNTRIES	OFF PACIFIC COAST STATES	OFF LATIN AMERICAN COUNTRIES	TOTAL
	QUANTITY	QUANTITY	QUANTITY	QUANTITY	QUANTITY
1922	1,200	6,160	28,018	7,932	35,950
1923	429	10,643	21,058	17,637	38,695
1924	681	2,444	23,043	5,284	28,327
1925	2,964	10,315	37,607	16,304	53,911
1926	2,695	9,870	26,050	16,604	42,654
1927	595	25,339	15,752	53,466	69,218
1928	83	32,168	18,330	43,720	62,050
1929	199	37,200	15,977	56,216	72,193
1930	36	56,618	18,936	80,411	99,347
1931	155	36,425	14,516	42,142	56,658
1932	165	36,758	1,620	58,631	60,251
1933	7	51,069	333	67,992	68,325
1934	19	60,894	18,432	75,790	94,222
1935	529	71,723	23,320	93,750	117,070
1936	767	77,586	24,017	101,237	125,254
1937	188	91,335	16,414	138,427	154,841
1938	11	78,307	34,222	102,204	136,426
1939	457	109,961	31,413	139,884	171,297
1940	238	113,522	36,574	168,308	204,882
1941	2	76,700	24,997	98,742	123,739
1942	1	41,466	31,467	85,120	116,587
1943	2	49,260	35,703	90,149	125,852
1944	(2)	63,144	59,108	107,212	166,320
1945	5	87,443	41,458	139,415	180,873
1946	33	127,214	32,489	182,020	214,509
1947	3	153,507	36,734	217,207	253,941
1948	(2)	199,427	25,580	290,423	316,003
1949	10	190,534	33,520	296,719	330,239
1950	1	187,888	48,861	340,991	389,852
1951	-	161,481	19,895	296,538	316,433
1952	(4)	(4)	(4)	(4)	5/ 328,000

1/ THE CATCH OF SKIPJACK AND YELLOWFIN IS INCLUDED WITH BLUEFIN.
2/ LESS THAN 500 POUNDS.
3/ INCLUDES A CATCH OF 132,000 POUNDS LANDED IN ALASKA.
4/ DATA NOT AVAILABLE.
5/ PARTLY ESTIMATED.
NOTE:--DATA FOR 1911 TO 1926 INCLUSIVE FROM UNITED STATES TARIFF COMMISSION REPORT TO THE UNITED STATES SENATE ON TUNA FISH, REPORT NO. 109, SECOND SERIES. JANUARY 3, 1936.

Table 53. - PACIFIC COAST STATES: BONITO AND YELLOWTAIL CATCH BY AREA OF CAPTURE, 1923 - 1952

AR	BONITO		YELLOWTAIL	
	OFF CALIFORNIA	OFF LATIN AMERICA	OFF CALIFORNIA	OFF LATIN AMERICA
	QUANTITY	QUANTITY	QUANTITY	QUANTITY
23	479	636	2,969	1,011
24	836	202	2,863	1,851
25	771	96	2,587	593
26	2,900	179	3,173	1,850
27	1,120	597	1,436	2,789
28	1,318	770	1,297	1,387
29	594	2,325	850	2,225
30	3,866	1,298	1,215	3,555
31	3,015	65	1,708	818
32	1,711	1,151	1,024	772
33	1,967	285	1,233	2,666
34	3,003	200	211	2,136
35	2,264	5,632	582	7,567
36	2,217	4,999	254	9,838
37	5,707	2,101	224	5,147
38	4,598	3,155	246	6,566
39	6,697	3,222	262	2,604
40	3,553	1,738	329	5,628
41	7,851	2,976	96	9,735
42	862	789	55	2,671
43	802	1,480	33	4,902
44	326	490	28	2,927
45	340	2,374	29	3,505
46	583	5,043	31	4,531
47	384	13,313	104	9,849
48	215	8,920	247	10,199
49	99	1,731	18	7,302
50	34	662	6	3,524
51	54	723	14	4,656
52	250	2,124	150	9,062

EAR	TOTAL		
	OFF CALIFORNIA	OFF LATIN AMERICA	TOTAL
	QUANTITY	QUANTITY	QUANTITY
923	3,448	1,647	5,095
924	3,699	2,053	5,752
925	3,358	689	4,047
926	6,073	2,029	8,102
927	2,556	3,386	5,942
928	2,615	2,157	4,772
929	1,444	4,550	5,994
930	5,081	4,853	9,934
931	4,723	883	5,606
932	2,735	1,923	4,658
933	3,200	2,951	6,151
934	3,214	2,336	5,550
935	2,846	13,199	16,045
936	2,471	14,837	17,308
937	5,931	7,248	13,179
938	4,844	9,721	14,565
939	6,959	5,826	12,785
940	3,882	7,366	11,248
941	7,947	12,711	20,658
942	917	3,460	4,377
943	835	6,382	7,217
944	354	3,417	3,771
945	369	5,879	6,248
946	614	9,574	10,188

(CONTINUED ON NEXT PAGE)

Table 53. - PACIFIC COAST STATES: BONITO AND YELLOWTAIL CATCH BY AREA OF CAPTURE, 1923 - 1952 - Continued

YEAR	TOTAL		
	OFF CALIFORNIA	OFF LATIN AMERICA	TOTAL
	QUANTITY	QUANTITY	QUANTITY
1947	488	23,162	23,650
1948	462	19,119	19,581
1949	117	9,033	9,150
1950	40	4,186	4,226
1951	68	5,379	5,447
1952	400	11,186	11,586

Table 54. - PACIFIC COAST STATES AND ALASKA: ALBACORE CATCH BY REGION, 1923 - 1952

YEAR	SOUTHERN CALIFORNIA		CENTRAL CALIFORNIA	NORTHERN CALIFORNIA
	OFF LATIN AMERICA	OFF CALIFORNIA		
	QUANTITY	QUANTITY	QUANTITY	QUANTITY
1923	27	12,488	(1)	-
1924	415	17,280	(1)	-
1925	522	21,225	460	-
1926	(1)	2,232	119	-
1927	124	4,454	1	-
1928	-	283	(1)	-
1929	(1)	269	-	-
1930	-	110	173	-
1931	-	7	30	-
1932	-	13	607	(1)
1933	-	(1)	(1)	-
1934	-	119	1	-
1935	61	1,703	683	-
1936	-	914	42	-
1937	-	1,437	583	(1)
1938	30	5,074	2,598	22
1939	4	5,002	4,991	3
1940	1	3,001	883	(1)
1941	-	2,166	1,176	(1)
1942	2,624	7,692	293	12

(CONTINUED ON NEXT PAGE)

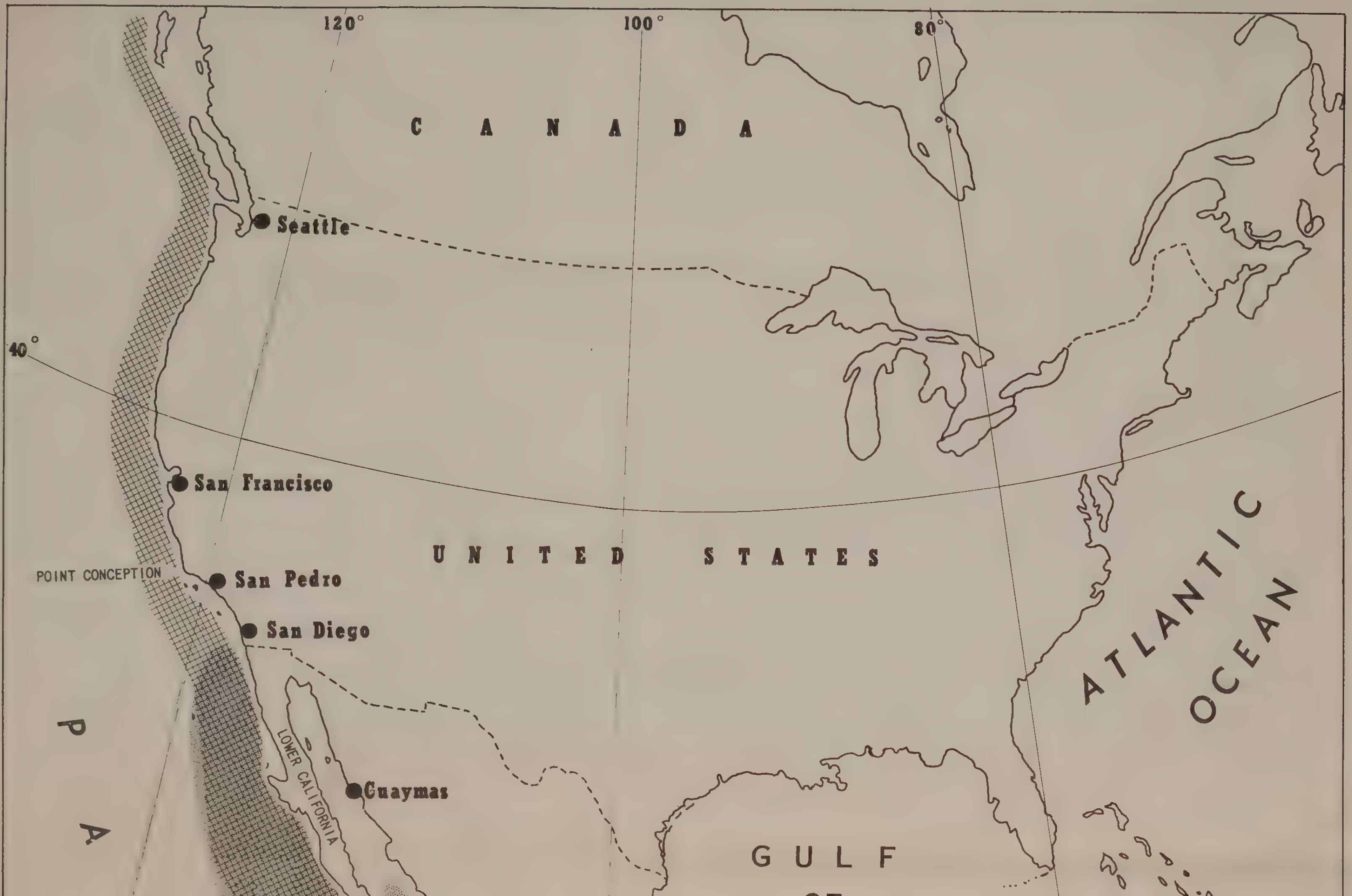
Table 54. - PACIFIC COAST STATES AND ALASKA: ALBACORE CATCH BY REGION, 1923 - 1952 - Continued

	SOUTHERN CALIFORNIA		CENTRAL CALIFORNIA	NORTHERN CALIFORNIA
	OFF LATIN AMERICA	OFF CALIFORNIA		
	QUANTITY	QUANTITY	QUANTITY	QUANTITY
943	9,499	10,621	774	488
944	9,775	8,355	225	78
945	12,262	8,551	372	90
946	8,963	8,784	261	61
947	5,762	5,489	1,645	531
948	25,927	7,192	2,630	732
949	23,577	11,008	6,630	2,818
950	23,576	16,935	15,634	5,601
951	17,622	5,595	5,647	2,052
952	(2)	(2)	(2)	(2)

EAR	OREGON	WASHINGTON	ALASKA	TOTAL
	QUANTITY	QUANTITY	QUANTITY	QUANTITY
923	-	-	-	12,515
924	-	-	-	17,695
925	-	-	-	22,207
926	-	-	-	2,351
927	-	-	-	4,579
928	-	-	-	283
929	(1)	-	-	269
930	3	-	-	286
931	-	-	-	37
932	-	-	-	620
933	2	-	-	2
934	1	-	-	121
935	1	-	-	2,448
936	28	-	-	984
937	1,079	421	-	3,520
938	5,869	4,133	-	17,726
939	6,485	2,437	-	18,922
940	9,286	1,331	-	14,502
941	7,545	1,045	-	11,932
942	10.943	1,976	-	23,540
943	10,386	5.750	-	37,518
944	22,492	11,870	-	52,795
945	12,178	6,030	-	39,483
946	3,951	2,122	-	24,142
947	9,174	4,243	-	26,844
948	7,963	4,917	132	49,493
949	6.327	4,434	-	54,794
950	5,386	5,283	-	72,415
951	2,950	625	-	34,491
952	(2)	(2)	-	(2)

/ LESS THAN 500 POUNDS.
/ DATA NOT AVAILABLE.
OTE:--SOUTHERN CALIFORNIA INCLUDES THE SAN DIEGO AND SAN PEDRO DISTRICTS; CENTRAL ALIFORNIA THE MONTEREY AND SAN FRANCISCO DISTRICTS; AND NORTHERN CALIFORNIA THE AREA ORTH OF THE SAN FRANCISCO REGION.

OPERATING AREA OF THE UNITED STATES TUNA FLEET IN THE PACIFIC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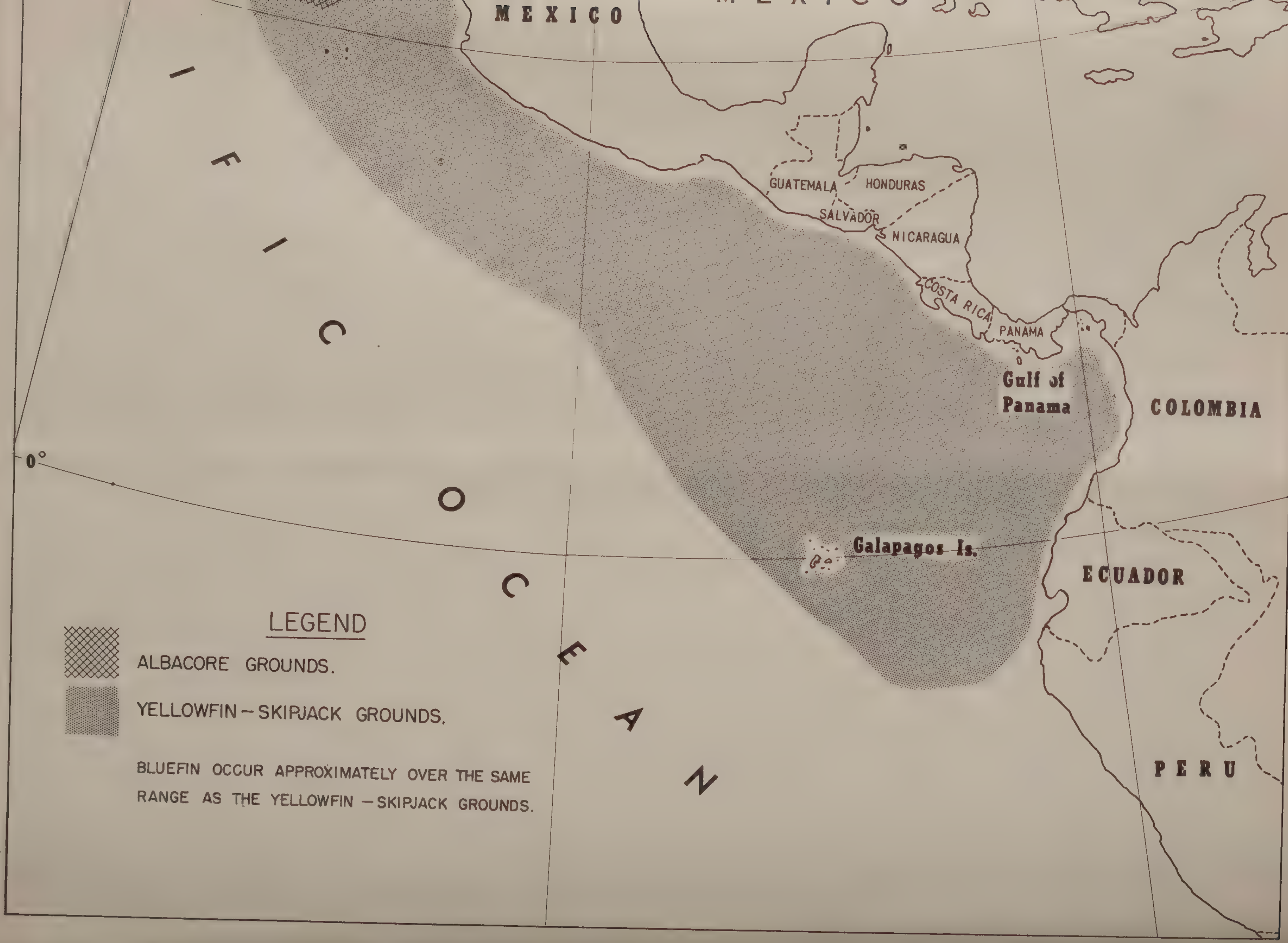
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I F I C O C E A N
0°
LEGEND
ALBACORE GROUNDS.
YELLOWFIN – SKIPJACK GROUNDS.
BLUEFIN OCCUR APPROXIMATELY OVER THE SAME RANGE AS THE YELLOWFIN – SKIPJACK GROUNDS.

U. S. FISH AND WILDLIFE SERVICE

3. Troll lines, operated from troll boats or simply "Trollers".

Table 55 is a tabulation of the Pacific Coast States operating nits engaged in tuna fishing in 1950 and 1951, including craft also perating in other fisheries. It includes Number of fishermen on ssels [7] and boats [8] and total fishermen; number and combined gistered net tonnage of vessels segregated into 10-ton size cateories, and total vessels and net tonnage; number and length in yards f seines, and number of lines and hooks. These data are given for ach major type of tuna fishing and for the total, exclusive of uplication. A description of the gear mentioned has been given reviously in Chapter I .

Table 56 is a similar tabulation of the fishermen and fishing raft engaged exclusively in tuna fishing in 1950 and 1951.

Table 57 gives like data on the fishermen and fishing craft ngaged in other fisheries in 1950 and 1951 as well as tuna fishing; hat is, it gives the total craft and fishermen engaged in tuna ishing and duplicated in other fisheries.

Data as to the quantity of the catch made with the principal ypes of gear used are given in table 58. The catches made with roll lines and bait lines are combined in this table under the eneral classification, "hooks and lines", since that was the only anner in which these particular data were available. Data for 930 and 1940 are shown along with 1950 for comparative purposes. ill and trammel net gear shown in this table are not covered in his sub-section because these nets are not a type of gear sed with the objective of catching tuna or tunalike fish. Any of he latter taken by this gear are only incidental to the capture of ther species of fish.

/ The term "vessel" as used in this and the following section applies only to craft of 5 net registered tons capacity and over.

/ The term "boat" as used in this and the following section applies to all craft of less than 5 net registered tons capacity.

TABLE 55.- TUNA OPERATING UNITS, PACIFIC COAST STATES, 1950 - 1951: BY GEAR AND SIZE CLASSIFICATION OF VESSELS INCLUDING CRAFT ALSO OPERATING IN OTHER FISHERIES

ITEM	TUNA PURSE SEINES		YELLOWFIN AND SKIPJACK BAIT LINE		ALBACORE	
					BAIT LINES	
	1950	1951	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER
FISHERMEN:						
ON VESSELS.	1,190	1,193	2,832	3,071	1,217	1,264
ON BOATS.	-	-	-	-	209	195
TOTAL.	1,190	1,193	2,832	3,071	1,426	1,459
VESSELS, MOTOR:						
5 TO 9 NET TONS . . .	1	-	3	3	90	117
10 TO 19 NET TONS . .	3	2	11	14	71	79
20 TO 29 NET TONS . .	-	2	12	13	32	30
30 TO 39 NET TONS . .	4	5	18	13	10	9
40 TO 49 NET TONS . .	4	7	6	8	3	3
50 TO 59 NET TONS . .	31	28	5	5	7	3
60 TO 69 NET TONS . .	24	24	8	7	5	-
70 TO 79 NET TONS . .	12	12	7	8	1	1
80 TO 89 NET TONS . .	11	9	12	13	4	2
90 TO 99 NET TONS . .	9	9	16	17	2	1
100 TO 109 NET TONS. .	2	2	6	6	-	-
110 TO 119 NET TONS. .	-	-	12	11	1	-
120 TO 129 NET TONS. .	-	-	12	14	-	-
130 TO 139 NET TONS. .	-	-	18	17	1	1
140 TO 149 NET TONS. .	1	1	7	7	-	-
150 TO 159 NET TONS. .	-	-	10	14	-	-
160 TO 169 NET TONS. .	-	-	6	10	-	-
170 TO 179 NET TONS. .	-	-	7	7	-	-
180 TO 189 NET TONS. .	-	-	12	16	-	-
190 TO 199 NET TONS. .	-	-	20	21	-	-
200 TO 209 NET TONS. .	-	-	3	3	-	-
210 TO 219 NET TONS. .	-	-	3	3	-	-
220 TO 229 NET TONS. .	-	-	4	4	-	-
230 TO 239 NET TONS. .	-	-	1	1	-	-
240 TO 249 NET TONS. .	-	-	3	2	-	-
260 TO 269 NET TONS. .	-	-	1	1	-	-
270 TO 279 NET TONS. .	-	-	2	2	-	-
300 TO 309 NET TONS. .	-	-	1	1	-	-
370 TO 379 NET TONS. .	-	-	1	1	-	-
380 TO 389 NET TONS. .	-	-	-	1	-	-
TOTAL VESSELS. . .	102	101	227	243	227	246
TOTAL NET TONS . .	6,680	6,545	26,702	29,219	4,414	3,802
BOATS, MOTOR.	-	-	-	-	47	51
APPARATUS:						
NUMBER.	102	101	2,832	3,071	1,426	1,450
LENGTH, YARDS	63,888	66,350	-	-	-	-
HOOKS..	-	-	2,832	3,071	1,426	1,450

ITEM	ALBACORE				TOTAL 1/	
	TROLL LINES		TOTAL			
	1950	1951	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER
FISHERMEN:						
ON VESSELS.	4,454	2,666	5,671	3,930	9,586	8,116
ON BOATS.	3,231	1,908	3,440	2,103	3,440	2,103
TOTAL.	7,685	4,574	9,111	6,033	13,026	10,219
VESSELS, MOTOR:						
5 TO 9 NET TONS . . .	753	418	843	535	846	538

(CONTINUED ON NEXT PAGE)

E 55.- TUNA OPERATING UNITS, PACIFIC COAST STATES, 1950 - 1951: BY R AND SIZE CLASSIFICATION OF VESSELS INCLUDING CRAFT ALSO OPERATING IN OTHER FISHERIES - Continued

ITEM	ALBACORE				TOTAL 1/	
	TROLL LINES		TOTAL			
	1950	1951	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER
SSELS, MOTOR - CONT'D:						
10 TO 19 NET TONS. . .	573	324	644	403	655	419
20 TO 29 NET TONS. . .	158	110	190	140	202	154
30 TO 39 NET TONS. . .	53	37	63	46	84	62
40 TO 49 NET TONS. . .	31	18	34	21	43	35
50 TO 59 NET TONS. . .	10	12	17	15	52	46
60 TO 69 NET TONS. . .	2	3	7	3	38	34
70 TO 79 NET TONS. . .	2	1	3	2	22	21
80 TO 89 NET TONS. . .	2	1	6	3	27	25
90 TO 99 NET TONS. . .	-	1	2	2	27	28
100 TO 109 NET TONS . .	2	1	2	1	10	9
110 TO 119 NET TONS . .	1	-	2	-	14	11
120 TO 129 NET TONS . .	-	-	-	-	12	14
130 TO 139 NET TONS . .	-	1	1	2	19	19
140 TO 149 NET TONS . .	-	-	-	-	8	8
150 TO 159 NET TONS . .	-	-	-	-	10	14
160 TO 169 NET TONS . .	-	-	-	-	6	10
170 TO 179 NET TONS . .	-	-	-	-	7	7
180 TO 189 NET TONS . .	-	-	-	-	12	16
190 TO 199 NET TONS . .	-	-	-	-	20	21
200 TO 209 NET TONS . .	-	-	-	-	3	3
210 TO 219 NET TONS . .	-	-	-	-	3	3
220 TO 229 NET TONS . .	-	-	-	-	4	4
230 TO 239 NET TONS . .	-	-	-	-	1	1
240 TO 249 NET TONS . .	-	-	-	-	3	2
260 TO 269 NET TONS . .	-	-	-	-	1	1
270 TO 279 NET TONS . .	-	-	-	-	2	2
300 TO 309 NET TONS . .	-	-	-	-	1	1
370 TO 379 NET TONS . .	-	-	-	-	1	1
380 TO 389 NET TONS . .	-	-	-	-	-	1
TOTAL VESSELS . . .	1,587	927	1,814	1,173	2,133	1,510
TOTAL NET TONS. . .	21,103	13,307	25,517	17,109	58,476	52,556
OATS, MOTOR	1,722	947	1,769	998	1,769	998
PPARATUS:						
NUMBER	23,910	13,407	-	-	-	-
HOOKS.	23,910	13,407	-	-	-	-

1/ EXCLUSIVE OF DUPLICATION.
OTE:--THE TERMS "VESSEL" APPLIES ONLY TO CRAFT WITH A REGISTERED NET CAPACITY OF 5 TONS AND OVER, WHEREAS THE TERMS "BOAT" APPLIES ONLY TO CRAFT UNDER 5 NET REGISTERED TONS CAPACITY.

TABLE 56.- CRAFT AND MEN FISHING TUNA ONLY, PACIFIC COAST STATES, 1950 - 1951: BY GEAR AND SIZE CLASSIFICATION OF VESSELS

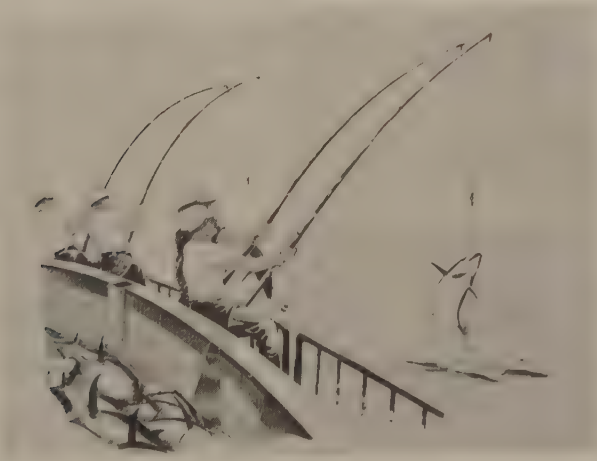
ITEM	TUNA PURSE SEINES		YELLOWFIN AND SKIPJACK BAIT LINE	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
FISHERMEN, ON VESSELS.	113	132	2,743	2,968
TOTAL	113	132	2,743	2,968
VESSELS, MOTOR:				
5 TO 9 NET TONS. . .	-	-	1	1
10 TO 19 NET TONS. .	-	-	7	11
20 TO 29 NET TONS. .	-	-	8	11
30 TO 39 NET TONS. .	-	-	16	12
40 TO 49 NET TONS. .	1	-	6	7
50 TO 59 NET TONS. .	-	-	5	5
60 TO 69 NET TONS. .	-	1	8	7
70 TO 79 NET TONS. .	1	-	7	8
80 TO 89 NET TONS. .	-	-	12	13
90 TO 99 NET TONS. .	6	7	16	17
100 TO 109 NET TONS.	1	1	6	6
110 TO 119 NET TONS.	-	-	12	9
120 TO 129 NET TONS.	-	-	12	14
130 TO 139 NET TONS.	-	-	17	16
140 TO 149 NET TONS.	-	1	7	7
150 TO 159 NET TONS.	-	-	10	14
160 TO 169 NET TONS.	-	-	6	10
170 TO 179 NET TONS.	-	-	7	7
180 TO 189 NET TONS.	-	-	12	16
190 TO 199 NET TONS.	-	-	20	21
200 TO 209 NET TONS.	-	-	3	3
210 TO 219 NET TONS.	-	-	3	3
220 TO 229 NET TONS.	-	-	4	4
230 TO 239 NET TONS.	-	-	1	1
240 TO 249 NET TONS.	-	-	3	2
260 TO 269 NET TONS.	-	-	1	1
270 TO 279 NET TONS.	-	-	2	2
300 TO 309 NET TONS.	-	-	1	1
370 TO 379 NET TONS.	-	-	1	1
380 TO 389 NET TONS.	-	-	-	1
TOTAL VESSELS . .	9	10	214	231
TOTAL NET TONS. .	795	982	26,342	28,673

ITEM	ALBACORE LINES		TOTAL	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
FISHERMEN:				
ON VESSELS	1,282	1,292	4,138	4,392
ON BOATS	1,338	1,035	1,338	1,035
TOTAL	2,620	2,327	5,476	5,427
VESSELS, MOTOR:				
5 TO 9 NET TONS. . .	211	212	212	213
10 TO 19 NET TONS. .	157	140	164	151
20 TO 29 NET TONS. .	48	45	56	56
30 TO 39 NET TONS. .	11	9	27	21
40 TO 49 NET TONS. .	1	2	8	9
50 TO 59 NET TONS. .	3	4	8	9
60 TO 69 NET TONS. .	2	-	10	8

(CONTINUED ON NEXT PAGE)

TABLE 56.- CRAFT AND MEN FISHING TUNA ONLY, PACIFIC COAST STATES, 1950 - 1951: BY GEAR AND SIZE CLASSIFICATION OF VESSELS - Continued

ITEM	ALBACORE LINES		TOTAL	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
VESSELS, MOTOR, CONTINUED				
70 TO 79 NET TONS. . .	2	1	10	9
80 TO 89 NET TONS. . .	4	3	16	16
90 TO 99 NET TONS. . .	2	2	24	26
100 TO 109 NET TONS. .	1	1	8	8
110 TO 119 NET TONS. .	1	-	13	9
120 TO 129 NET TONS. .	-	-	12	14
130 TO 139 NET TONS. .	1	-	18	16
140 TO 149 NET TONS. .	-	-	7	8
150 TO 159 NET TONS. .	-	-	10	14
160 TO 169 NET TONS. .	-	-	6	10
170 TO 179 NET TONS. .	-	-	7	7
180 TO 189 NET TONS. .	-	-	12	16
190 TO 199 NET TONS. .	-	-	20	21
200 TO 209 NET TONS. .	-	-	3	3
210 TO 219 NET TONS. .	-	-	3	3
220 TO 229 NET TONS. .	-	-	4	4
230 TO 239 NET TONS. .	-	-	1	1
240 TO 249 NET TONS. .	-	-	3	2
260 TO 269 NET TONS. .	-	-	1	1
270 TO 279 NET TONS. .	-	-	2	2
300 TO 309 NET TONS. .	-	-	1	1
370 TO 379 NET TONS. .	-	-	1	1
380 TO 389 NET TONS. .	-	-	-	1
TOTAL VESSELS . . .	444	419	667	660
TOTAL NET TONS. . .	6,492	5,629	33,629	35,284
OATS, MOTOR	744	455	744	455



BAIT FISHING FOR TUNA

TABLE 57.- CRAFT AND MEN FISHING TUNA AS WELL AS OTHER FISH, PACIFIC COAST STATES, 1950 - 1951: BY GEAR AND SIZE CLASSIFICATION OF VESSELS

ITEM	TUNA PURSE SEINES		YELLOWFIN AND SKIPJACK BAIT LINE	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
FISHERMEN, ON VESSELS.	1,077	1,061	89	103
TOTAL	1,077	1,061	89	103
VESSELS, MOTOR:				
5 TO 9 NET TONS. . .	1	-	2	2
10 TO 19 NET TONS. .	3	2	4	3
20 TO 29 NET TONS. .	-	2	4	2
30 TO 39 NET TONS. .	4	5	2	1
40 TO 49 NET TONS. .	3	7	-	1
50 TO 59 NET TONS. .	31	28	-	-
60 TO 69 NET TONS. .	24	23	-	-
70 TO 79 NET TONS. .	11	12	-	-
80 TO 89 NET TONS. .	11	9	-	-
90 TO 99 NET TONS. .	3	2	-	-
100 TO 109 NET TONS.	1	1	-	-
110 TO 119 NET TONS.	-	-	-	2
130 TO 139 NET TONS.	-	-	1	1
140 TO 149 NET TONS.	1	-	-	-
TOTAL VESSELS. . .	93	91	13	12
TOTAL NET TONS . .	5,885	5,563	360	546

ITEM	ALBACORE LINES		TOTAL 1/	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
FISHERMEN:				
ON VESSELS	4,389	2,638	5,448	3,724
ON BOATS	2,102	1,068	2,102	1,068
TOTAL.	6,491	3,706	7,550	4,792
VESSELS, MOTOR:				
5 TO 9 NET TONS. . .	632	323	634	325
10 TO 19 NET TONS. .	487	263	491	268
20 TO 29 NET TONS. .	142	95	146	98
30 TO 39 NET TONS. .	52	37	57	41
40 TO 49 NET TONS. .	33	19	35	26
50 TO 59 NET TONS. .	14	11	44	37
60 TO 69 NET TONS. .	5	3	28	26
70 TO 79 NET TONS. .	1	1	12	12
80 TO 89 NET TONS. .	2	-	11	9
90 TO 99 NET TONS. .	-	-	3	2
100 TO 109 NET TONS.	1	-	2	1
110 TO 119 NET TONS.	1	-	1	2
130 TO 139 NET TONS.	-	2	1	3
140 TO 149 NET TONS.	-	-	1	-
TOTAL VESSELS. . .	1,370	754	1,466	850
TOTAL NET TONS . .	19,025	11,480	24,847	17,272
BOATS, MOTOR . . .	1,025	543	1,025	543

1/ EXCLUSIVE OF DUPLICATION.

ABLE 58. - PACIFIC COAST STATES: CATCH OF TUNA AND TUNALIKE FISHES BY GEAR, 1930, 1940, and 1950

ear and species	1930	1940	1950
	Pounds	Pounds	Pounds
rse seines and ampara nets:			
Albacore	-	157,000	7,900
Bluefin	21,919,600	19,904,400	2,722,300
Skipjack	38,051	13,098,500	11,874,800
Yellowfin	1,545,834	15,237,400	39,678,700
Bonito	3,775,735	4,751,600	494,800
Yellowtail	2,305,311	3,189,200	2,120,400
Total	29,584,531	56,338,100	56,898,900
ook and lines:			
Albacore	286,283	14,344,800	72,406,700
Bluefin	1,682	60,100	39,500
Skipjack	20,447,536	43,551,700	114,911,300
Yellowfin	55,108,347	98,522,500	148,210,800
Bonito	1,320,649	499,900	197,500
Yellowtail	2,429,418	2,752,200	1,408,100
Total	79,593,915	159,731,200	337,173,900
ill and trammel ets 1/:			
Bluefin	-	5,800	-
Bonito	67,876	39,500	3,300
Yellowtail	35,699	15,400	1,300
Total	103,575	60,700	4,600
Grand total	109,282,021	216,130,000	394,077,400

/ Tuna and tunalike fishes caught by this gear were taken incidentally hile fishing for other species.

Atlantic and Gulf Coast States

Complete data on the types of fishing employed to catch tuna and tunalike fishes in the Atlantic and Gulf Coast States Area are not always available. Fortunately, the detailed statistical survey of the catch of these fish made for the year 1950 affords the best source of information on this subject. For that year no tuna or tunalike fish were caught commercially along the Gulf Coast. The only commercial catch made in that year was along the Atlantic Coast. Detail on the quantity and value of this catch by States and gear are shown in table 59.

INTER-RELATIONSHIP OF TUNA FISHING WITH OTHER TYPES OF FISHING (SALMON, HALIBUT, SARDINES, ETC.)

In considering this question, which is particularly applicable to the Pacific Coast States and is considered for that area only, one must bear in mind that all persons seeking a livelihood from fishing as in other occupations will endeavor to engage in those fisheries and types of fishing that will yield the largest annual income. In addition fishermen will consider the fishery to which they are personally adapted, and for which their individual fishing crafts are suited and can be equipped. It should also be borne in mind that weather conditions and rough seas, particularly from Central California northward, prevent many of the craft, small and large, from operating on a year round basis, and that many of the smaller craft, limited by fuel capacity or other reasons, must confine their fishing activities to within a few miles from shore and even in many instances to within a relatively short radius of their homeport.

Because of these limitations, and in order to produce the largest annual income, the fishermen must select not only those fisheries for which they and their craft are best equipped and adapted, but also those which are most remunerative at each particular period or season of the year. Quite a number of fishermen will supplement their fishing activities with employment in other occupations on land, or others, employed chiefly in land occupations, may endeavor to supplement their income from such employment by engaging in fisheries for such periods of time as they can spare from their land occupations. The type of vessel and its rigging and equipment also have a large bearing in determining for what fisheries a particular craft may be used.

Table 59. - ATLANTIC COAST STATES: TUNA AND BONITO CATCH BY STATE AND GEAR, 1950

IES AND STATE	HAUL SEINES		PURSE SEINES		GILL NETS		LINES, HAND TROLL AND TRAWL	
	POUNDS	VALUE	POUNDS	VALUE	POUNDS	VALUE	POUNDS	VALUE
FIN TUNA:								
INE	-	-	1,600	$147	100	$3	18,900	$1,744
SSACHUSETTS	-	-	-	-	1,500	142	155,000	10,307
W YORK	-	-	-	-	-	-	84,700	10,600
W JERSEY	-	-	-	-	2,000	200	-	-
TOTAL	-	-	1,600	147	3,600	345	258,600	22,651
LE TUNA:								
W JERSEY	-	-	-	-	-	-	700	20
RYLAND	-	-	-	-	-	-	100	13
RGINIA	4,300	$172	-	-	-	-	-	-
RTH CAROLINA	133,000	3,990	-	-	200	6	-	-
TOTAL	137,300	4,162	-	-	200	6	800	33
TO:								
EW JERSEY	-	-	-	-	-	-	100	20
IRGINIA	8,500	1,098	-	-	-	-	-	-
RTH CAROLINA	7,800	235	-	-	-	-	-	-
LORIDA	1,600	80	-	-	20,000	1,000	42,400	2,070
TOTAL	17,900	1,413	-	-	20,000	1,000	42,500	2,090
AL, TUNA AND NITO:								
AINE	-	-	1,600	147	100	3	18,900	1,744
ASSACHUSETTS	-	-	-	-	1,500	142	155,000	10,307
EW YORK	-	-	-	-	-	-	84,700	10,600
EW JERSEY	-	-	-	-	2,000	200	800	40
ARYLAND	-	-	-	-	-	-	100	13
IRGINIA	12,800	1,270	-	-	-	-	-	-
ORTH CAROLINA	140,800	4,225	-	-	200	6	-	-
LORIDA	1,600	80	-	-	20,000	1,000	42,400	2,070
TOTAL	155,200	5,575	1,600	147	23,800	1,351	301,900	24,774

CIES AND STATE	HARPOONS		POUND NETS AND FLOATING TRAPS	
	POUNDS	VALUE	POUNDS	VALUE
EFIN TUNA:				
AINE	198,100	$16,520	-	-
ASSACHUSETTS	8,500	594	678,900	$59,795
HODE ISLAND	18,300	1,799	42,500	4,192
EW YORK	-	-	31,000	3,650
EW JERSEY	-	-	11,800	1,255
TOTAL	224,900	18,913	764,200	68,892
TLE TUNA:				
EW YORK	-	-	13,900	1,700
EW JERSEY	-	-	134,100	4,555
IRGINIA	-	-	8,100	330
TOTAL	-	-	156,100	6,585
ITO:				
ASSACHUSETTS	-	-	4,300	428
HODE ISLAND	-	-	400	38
EW YORK	-	-	3,000	450
IRGINIA	-	-	35,200	4,274
TOTAL	-	-	42,900	5,190

(CONTINUED ON NEXT PAGE)

Table 59. - ATLANTIC COAST STATES: TUNA AND BONITO CATCH BY STATE AND GEAR, 1950 - Continued

SPECIES AND STATE	HARPOONS		POUND NETS AND FLOATING TRAPS	
	POUNDS	VALUE	POUNDS	VALUE
TOTAL, TUNA AND BONITO:				
MAINE	198,100	$16,520	-	-
MASSACHUSETTS	8,500	594	683,200	$60,223
RHODE ISLAND	18,300	1,799	42,900	4,230
NEW YORK	-	-	47,900	5,800
NEW JERSEY	-	-	145,900	5,810
VIRGINIA	-	-	43,300	4,604
TOTAL	224,900	18,913	963,200	80,667

SPECIES AND STATE	OTTER TRAWLS		TOTAL	
	POUNDS	VALUE	POUNDS	VALUE
BLUEFIN TUNA:				
MAINE	-	-	218,700	$18,414
MASSACHUSETTS	1,500	$83	845,400	70,921
RHODE ISLAND	-	-	60,800	5,991
CONNECTICUT	10,200	995	10,200	995
NEW YORK	2,600	340	118,300	14,590
NEW JERSEY	-	-	13,800	1,455
TOTAL	14,300	1,418	1,267,200	112,366
LITTLE TUNA:				
NEW YORK	200	27	14,100	1,727
NEW JERSEY	-	-	134,800	4,575
MARYLAND	-	-	100	13
VIRGINA	1,300	52	13,700	554
NORTH CAROLINA	-	-	133,200	3,996
TOTAL	1,500	79	295,900	10,865
BONITO:				
MASSACHUSETTS	-	-	4,300	428
RHODE ISLAND	-	-	400	38
NEW YORK	100	5	3,100	455
NEW JERSEY	100	30	200	50
VIRGINIA	-	-	43,700	5,372
NORTH CAROLINA	-	-	7,800	235
FLORIDA	-	-	64,000	3,150
TOTAL	200	35	123,500	9,728
TOTAL, TUNA AND BONITO:				
MAINE	-	-	218,700	18,414
MASSACHUSETTS	1,500	83	849,700	71,349
RHODE ISLAND	-	-	61,200	6,029
CONNECTICUT	10,200	995	10,200	995
NEW YORK	2,900	372	135,500	16,772
NEW JERSEY	100	30	148,800	6,080
MARYLAND	-	-	100	13
VIRGINIA	1,300	52	57,400	5,926
NORTH CAROLINA	-	-	141,000	4,231
FLORIDA	-	-	64,000	3,150
TOTAL	16,000	1,532	1,686,600	132,959

Table 60 shows for the years 1950 and 1951, the craft and men sing both tuna and other gear, and the total of such duplications. h following discussion describes in more detail the inter-relationhip between the tuna and other fisheries based on the data for the r 1950 given in table 60.

Duplications With Tuna Purse Seines

Table 56 reveals that only 9 of the fleet of 102 tuna purse einers were engaged exclusively in tuna fishing with purse seines in 50 and table 60 shows what fisheries the other 93 vessels engaged in hen not fishing tuna. Some of these vessels engaged in more than one shery besides the tuna fishery. The vessels of the tuna purse seine eet are based largely at San Pedro, but include also a few based San Diego. All but one of the San Diego vessels operate a modified rm of purse seine for local bluefin only, converting to albacore shing, either with bait or troll lines, during the season when bacore are abundant in southern California waters. They also fish lchards (sardines) with purse seines during the sardine season. One these vessels also operated sea bass gill nets for a short period 1950. A very limited number of the tuna purse seine fleet have eir home port at Monterey and San Francisco, but these also base San Pedro during the tuna purse seining season.

The main body of the tuna purse seine fleet are vessels that re built to engage in a combination of seining operations, such as r sardines, mackerels, and tunas. A limited few will also purse ine for market fishes, chiefly barracuda, off Lower California, when rket conditions are favorable. The above is confirmed in table 60, ich reveals that in 1950, 91 vessels of the fleet also were used r sardine seining, 27 also for mackerel seining, and 2 for barracuda d other market fishes. The sardine season set by California law, arts in central and northern California on August 1, and ends nuary 15, and starts in southern California on October 1, and ends on bruary 1. The mackerel seining season on which no legal season is et, usually starts in August and ends in February or March, but these ish may be taken in lesser quantities in other months also. Thus it ay be seen that the fleet of seiners can have practically a year ound operation by fishing for pilchards during the southern California eason, and for tuna in late winter and spring. In late summer and arly fall they may go to Monterey or San Francisco to fish for ardines or they may fish mackerels, principally jack mackerel in

TABLE 60.- CRAFT AND MEN USING BOTH TUNA AND OTHER GEAR, PACIFIC COAST STATES, 1950 - 1951

ITEM	DUPLICATED WITH			
	PURSE SEINES, TUNA		LINES, YELLOWFIN AND SKIPJACK	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
SEINES, BARRACUDA:				
FISHERMEN:				
ON VESSELS.	18	-	-	-
VESSELS, MOTOR. . . .	2	-	-	-
NET TONS.	68	-	-	-
SEINES, MACKEREL:				
FISHERMEN, ON VESSELS	316	652	-	-
TOTAL.	316	652	-	-
VESSELS, MOTOR. . . .	27	56	-	-
NET TONS.	1,627	3,137	-	-
SEINES, PILCHARD:				
FISHERMEN, ON VESSELS	1,054	1,061	12	20
TOTAL.	1,054	1,061	12	20
VESSELS, MOTOR. . . .	91	91	2	3
NET TONS.	5,809	5,563	20	66
SEINES, OTHER:				
FISHERMEN, ON VESSELS	-	11	10	-
TOTAL.	-	11	10	-
VESSELS, MOTOR. . . .	-	1	2	-
NET TONS.	-	38	31	-
GILL NETS, SEA BASS:				
FISHERMEN, ON VESSELS	7	-	-	-
TOTAL.	7	-	-	-
VESSELS, MOTOR. . . .	1	-	-	-
NET TONS.	16	-	-	-
TRAMMEL NETS:				
FISHERMEN, ON VESSELS	-	9	-	-
TOTAL.	-	9	-	-
VESSELS, MOTOR. . . .	-	1	-	-
NET TONS.	-	19	-	-
LINES, TRAWL, SET AND HAND:				
FISHERMEN, ON VESSELS	-	-	53	59
TOTAL.	-	-	53	59
VESSELS, MOTOR. . . .	-	-	8	7
NET TONS.	-	-	151	317
TRAPS, LOBSTER:				
FISHERMEN, ON VESSELS	-	-	-	5
TOTAL.	-	-	-	5

(CONTINUED ON NEXT PAGE)

TABLE 60. - CRAFT AND MEN USING BOTH TUNA AND OTHER GEAR, PACIFIC COAST STATES, 1950 - 1951 - Continued

ITEM	DUPLICATED WITH			
	PURSE SEINES, TUNA		LINES, YELLOWFIN AND SKIPJACK	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
PS, LOBSTER - CONT'D:				
ESSELS, MOTOR.	-	-	-	1
NET TONS.	-	-	-	27
POONS, SWORDFISH:				
ISHERMEN, ON VESSELS . .	-	19	28	-
TOTAL.	-	19	28	-
ESSELS, MOTOR.	-	1	3	-
NET TONS.	-	139	204	-

ITEM	DUPLICATED WITH			
	LINES, ALBACORE		TOTAL 1/	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
NES, BARRACUDA:				
ISHERMEN:				
ON VESSELS.	26	24	44	24
ESSELS, MOTOR.	3	3	5	3
NET TONS.	69	65	137	65
NES, MACKEREL:				
ISHERMEN:				
ON VESSELS.	136	73	414	668
ON BOATS.	8	6	8	6
TOTAL.	144	79	422	674
ESSELS, MOTOR.	17	7	41	58
NET TONS.	457	260	1,920	7,168
OATS, MOTOR.	1	1	1	1
NES, SALMON:				
ISHERMEN:				
ON VESSELS.	5	8	5	8
ESSELS, MOTOR.	1	1	1	1
NET TONS.	22	32	22	32
NES, PILCHARD:				
ISHERMEN:				
ON VESSELS.	561	314	1,532	1,356
ON BOATS.	105	37	105	37
TOTAL.	666	351	1,637	1,393
ESSELS, MOTOR.	85	43	169	137
NET TONS.	1,850	881	7,272	6,241
OATS, MOTOR.	12	7	12	7
INES, OTHER:				
ISHERMEN:				
ON VESSELS.	173	142	183	153
ON BOATS.	162	106	162	106
TOTAL.	335	248	345	259

(CONTINUED ON NEXT PAGE)

TABLE 60.- CRAFT AND MEN USING BOTH TUNA AND OTHER GEAR, PACIFIC COAST STATES, 1950 - 1951 - Continued

ITEM	DUPLICATED WITH			
	LINES, ALBACORE		TOTAL 1/	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
SEINES, OTHER - CONT'D:				
VESSELS, MOTOR.	41	33	43	34
NET TONS.	338	303	369	341
BOATS, MOTOR.	35	28	35	28
GILL NETS, BARRACUDA:				
FISHERMEN:				
ON VESSELS.	39	35	39	35
ON BOATS.	55	39	55	39
TOTAL.	94	74	94	74
VESSELS, MOTOR.	10	8	10	8
NET TONS.	71	52	71	52
BOATS, MOTOR.	21	13	21	13
GILL NETS, CALIFORNIA HALIBUT:				
FISHERMEN:				
ON BOATS.	2	-	2	-
BOATS, MOTOR.	1	-	1	-
GILL NETS, CRAB:				
FISHERMEN:				
ON VESSELS.	-	2	-	2
VESSELS, MOTOR.	-	1	-	1
NET TONS.	-	5	-	5
GILL NETS, SALMON:				
FISHERMEN:				
ON VESSELS.	15	-	15	-
ON BOATS.	8	-	8	-
TOTAL.	23	-	23	-
VESSELS, MOTOR.	8	-	8	-
NET TONS.	104	-	104	-
BOATS, MOTOR.	4	-	4	-
GILL NETS, SEA BASS:				
FISHERMEN:				
ON VESSELS.	81	55	81	55
ON BOATS.	123	86	123	86
TOTAL.	204	141	204	141
VESSELS, MOTOR.	22	13	22	13
NET TONS.	193	97	193	97
BOATS, MOTOR.	48	29	48	29
GILL NETS, SHAD:				
FISHERMEN:				
ON BOATS.	2	-	2	-
BOATS, MOTOR.	1	-	1	-
GILL NETS, SHARK:				
FISHERMEN:				
ON VESSELS.	156	71	156	71
ON BOATS.	43	55	43	55
TOTAL.	199	126	199	126

(CONTINUED ON NEXT PAGE)

TABLE 60.- CRAFT AND MEN USING BOTH TUNA AND OTHER GEAR, PACIFIC COAST STATES, 1950 - 1951 - Continued

ITEM	DUPLICATED WITH			
	LINES, ALBACORE		TOTAL 1/	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
LL NETS, SHARK - CONT'D:				
VESSELS, MOTOR.	38	18	38	18
NET TONS.	738	238	738	238
BOATS, MOTOR.	19	20	19	20
LL NETS, OTHER:				
FISHERMEN:				
ON VESSELS.	24	13	24	13
ON BOATS.	43	47	43	47
TOTAL.	67	60	67	60
VESSELS, MOTOR.	9	4	9	4
NET TONS.	79	160	79	160
BOATS, MOTOR.	22	21	22	21
RAMMEL NETS:				
FISHERMEN:				
ON VESSELS.	85	46	85	55
ON BOATS.	66	48	66	48
TOTAL.	151	94	151	103
VESSELS, MOTOR.	22	11	22	12
NET TONS.	184	78	184	97
BOATS, MOTOR.	22	16	22	16
INES, TROLL, SALMON:				
FISHERMEN:				
ON VESSELS.	2,188	887	2,188	887
ON BOATS.	382	243	382	243
TOTAL.	2,570	1,130	2,570	1,130
VESSELS, MOTOR.	771	372	771	372
NET TONS.	8,317	4,755	8,317	4,755
BOATS, MOTOR.	273	146	273	146
INES, TRAWL, SET AND HAND:				
FISHERMEN:				
ON VESSELS.	1,658	1,214	1,711	1,273
ON BOATS.	749	509	749	509
TOTAL.	2,407	1,723	2,460	1,782
VESSELS, MOTOR.	384	269	392	276
NET TONS.	6,791	4,717	6,942	5,034
BOATS, MOTOR.	414	265	414	265
YKE NETS:				
FISHERMEN:				
ON BOATS.	2	-	2	-
BOATS, MOTOR.	1	-	1	-
DIP NETS:				
FISHERMEN:				
ON VESSELS.	7	6	7	6
ON BOATS.	9	-	9	-
TOTAL.	16	6	16	6
VESSELS, MOTOR.	4	3	4	3
NET TONS.	35	29	35	29
BOATS, MOTOR.	6	-	6	-

(CONTINUED ON NEXT PAGE)

TABLE 60.- CRAFT AND MEN USING BOTH TUNA AND OTHER GEAR, PACIFIC COAST STATES, 1950 - 1951 - Continued

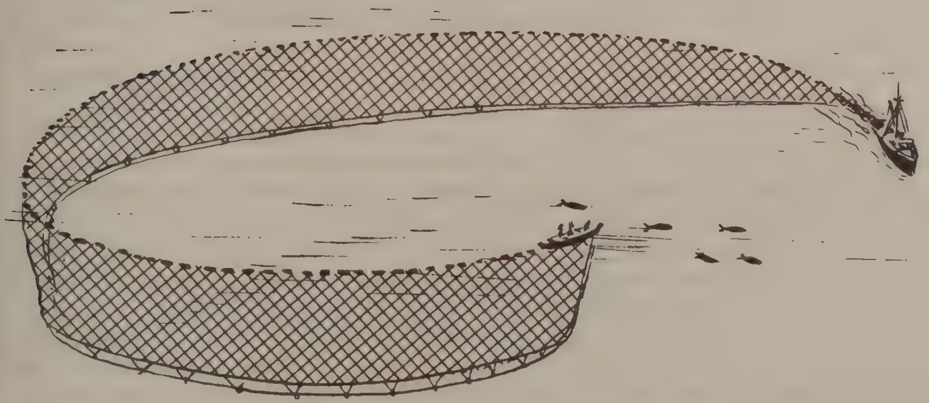
ITEM	DUPLICATED WITH			
	LINES, ALBACORE		TOTAL 1/	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
BRAIL OR SCOOP NETS:				
FISHERMEN:				
ON VESSELS.	248	105	248	105
ON BOATS.	556	228	556	228
TOTAL.	804	333	804	333
VESSELS, MOTOR.	93	36	93	36
NET TONS.	744	270	744	270
BOATS, MOTOR.	268	114	268	114
BEAM TRAWLS:				
FISHERMEN:				
ON BOATS.	1	-	1	-
BOATS, MOTOR.	1	-	1	-
OTTER TRAWLS:				
FISHERMEN:				
ON VESSELS.	362	128	362	128
ON BOATS.	46	19	46	19
TOTAL.	408	147	408	147
VESSELS, MOTOR.	85	29	85	29
NET TONS.	2,046	699	2,046	699
BOATS, MOTOR.	12	5	12	5
TRAPS, CRABS:				
FISHERMEN:				
ON VESSELS.	642	220	642	220
ON BOATS.	145	45	145	45
TOTAL.	787	265	787	265
VESSELS, MOTOR.	257	87	257	87
NET TONS.	2,733	1,072	2,733	1,072
BOATS, MOTOR.	108	32	108	32
TRAPS, LOBSTER:				
FISHERMEN:				
ON VESSELS.	115	88	115	93
ON BOATS.	285	165	285	165
TOTAL.	400	253	400	258
VESSELS, MOTOR.	40	27	40	28
NET TONS.	319	181	319	208
BOATS, MOTOR.	148	81	148	81
TRAPS, OCTOPUS:				
FISHERMEN:				
ON BOATS.	2	2	2	2
BOATS, MOTOR.	1	1	1	1
HARPOONS, SHARK:				
FISHERMEN:				
ON VESSELS.	7	17	7	17
ON BOATS.	7	31	7	31
TOTAL.	14	48	14	48
VESSELS, MOTOR.	2	6	2	6
NET TONS.	11	36	11	36
BOATS, MOTOR.	3	11	3	11

(CONTINUED ON NEXT PAGE)

TABLE 60.- CRAFT AND MEN USING BOTH TUNA AND OTHER GEAR, PACIFIC COAST STATES, 1950 - 1951 - Continued

ITEM	DUPLICATED WITH			
	LINES, ALBACORE		TOTAL 1/	
	1950	1951	1950	1951
	NUMBER	NUMBER	NUMBER	NUMBER
RPOONS, SWORDFISH:				
FISHERMEN:				
ON VESSELS.	33	93	61	112
ON BOATS.	53	102	53	102
TOTAL.	86	195	114	214
VESSELS, MOTOR.	9	28	12	29
NET TONS.	73	209	277	348
BOATS, MOTOR.	19	41	19	41
BALONE OUTFITS:				
FISHERMEN:				
ON VESSELS.	17	7	17	7
ON BOATS.	60	23	60	23
TOTAL.	77	30	77	30
VESSELS, MOTOR.	6	3	6	3
NET TONS.	50	20	50	20
BOATS, MOTOR.	29	11	29	11

/ EXCLUSIVE OF DUPLICATION.



TYPICAL WEST COAST TUNA PURSE-SEINE OPERATION southern California, or if the demand exists for bonito and yellowtail they may make a trip or two to banks off Lower California for these species as well as for the various species of tuna.

With the decline in the availability of sardines and Pacific mackerel during the past six or seven seasons, combined with comparatively poor runs of bluefin tuna in local waters, the fishermen of the tuna purse seine fleet have had to rely much more on tuna fishing.

Duplication With Bait Lines, Yellowfin and Skipjack

Table 57 reveals that only 13 vessels of the clipper fleet fishing primarily for yellowfin and skipjack with bait lines, were duplicated in fisheries other than tuna fishing during 1950. These with one exception, were vessels in the lowest tonnage categories. However, a greater number, 31 including some craft up to medium size, also made trips primarily for albacore. Since these craft used the same gear for albacore as for yellowfin and skipjack, they are not duplicated in the albacore fleet in any of the statistical tables.

Fishermen of this fleet will at times when at anchor, and usually for their own consumption, fish for other species of fish with hand lines or pole and line, but may bring in any surplus of market fish so taken. Similarly, when cruising for tuna they may endeavor, sometimes successfully, to harpoon any swordfish that they encounter.

Only four of the smallest of the fleet engaged in such otherwise unprofitable incidental fishing. Two of these operated a modified form of a purse seine for sardines, and two others operated their bait seines commercially for bait fish at times when no tunas were within their limited cruising range. These four, perhaps, should be more rightly classified with the albacore fleet.

In general, it may be said that the vessels of the clipper fleet are not adaptable to other types of fishing, since the removal of bait tanks and other conversions required for other types of fishing, except on the very smallest craft, is too expensive and time consuming. Consequently, whether the vessels of this fleet operate at a profit or loss depends solely upon their tuna catch.

Duplications With Lines, Albacore

In this phase of the report the operation of the albacore fleet will be divided into three groups on the basis of their home port;

at is, (1) those based in Washington and Oregon, (2) those in rthern and central California, and (3) those in southern California.

The albacore fleet of Washington and Oregon consists, except r those built in the past decade, of craft originally built for gaging in fisheries other than tuna. Many of them still rely heavily their efforts to derive an adequate annual income from fishing erations other than for tuna. The total Washington-Oregon albacore eet in 1950 consisted of approximately 750 vessels and 80 boats. e remainder of the fleet are from California.

All of the boats and a large majority of the vessels based in shington and Oregon fished for albacore in waters off Washington d Oregon, and about half the vessels also fished albacore in Cali- rnia waters.

The principal fishing operations of this group in 1950 other than at for tuna consisted of fishing for halibut with trawl lines, for lmon with troll lines, for various bottom fishes with otter trawls, r sharks with gill nets, and for crabs with traps or pots. Approxi- tely 160 of the vessels fished for halibut, the season for which ually starts about May 1, and extends possibly into July, but in cent years has ended in June. Following the halibut season some of em may come directly down to California waters to fish for albacore may change over to salmon trolling, otter trawling, or some other shery until late summer when albacore become available off the shington-Oregon coast.

Fishing for bottom fishes, principally those of the flounder mily, may be engaged in throughout the year whenever weather permits. st of the otter trawlers do engage in such operations on a year und basis. In some instances, trolling for albacore may be simul- neously conducted with otter trawling by these craft as they proceed and from their fishing banks, or they may suspend their trawling erations whenever exceptional runs of albacore are available in the rthern California and/or Washington-Oregon waters.

The season for salmon trolling off Washington-Oregon, normally arts early in May and is usually over by mid-September. However, lmon may not prove sufficiently abundant even in August to justify mmercial operations. Since the lines used for salmon trolling may readily inter-changed with those for albacore trolling, albacore shing will start whenever the albacore appear in such nothern waters sufficient quantities to be more remunerative than salmon trolling.

Gill netting for sharks, dwindling for some years, has been almost entirely eliminated since 1950 on the Pacific Coast due to the low price being paid for shark livers.

Crab fishing may also be conducted, except possibly for a couple winter months, on a year round basis except in California where the law prohibits taking of crabs from August 1 through November 15 of each year. Most of the crab fishermen are also salmon trollers. It may be pointed out here that salmon trolling and crab fishing are carried on largely in inshore waters within a few miles of the coast line. The albacore, on the other hand, usually are found farther offshore but may run in closer following hot spells that warm up the inshore waters. Many of the smaller craft are not capable of pursuing the albacore to their outer offshore range and thus are limited to taking them only when they appear closer inshore.

The craft having their home ports in California, north of Point Conception, consist of a very mixed group of various types and sizes. This group includes sardine purse seiners, salmon trollers, crab fishermen, set line and hand line fishermen, and even a very few of other types that oridinarily fish exclusively in bays and rivers rather than in the open ocean waters. For the past five or six years, sardine fishing north of Point Conception has been only fair to almost a complete failure. As a result, many of the sardine seiners in this area have been forced to enter other fisheries as a means of livelihood. They can, by removing turntables and heavy nets, and by equipping their vessels with outrigger poles, be fairly readily adapted for albacore trolling. This practice has become increasingly more prevalent as the sardines declined.

As mentioned above, crab fishing in California is limited to the season from November 16 through July 31, and salmon trolling may be carried on, starting usually in April, off Monterey and a month or so later farther northward and continuing into early September. Most of the crab fishermen and salmon trollers are identical since there are only a few months of overlapping of seasons in these two fisheries. As the season tends to dwindle in August and since there is no other fishery open thereafter for some months, the majority of that fleet will fish for albacore starting in some years in late July and usually ending sometime in October. However, some of the more seaworthy craft may be able to fish in farther offshore waters into November or possibly even December. Some of the albacore ollers, especially those at Monterey, will fish set lines for bottom sh, principally rock fish, during the fall and winter months following e albacore season and at such times as weather permits. These craft e mostly undertonnage craft (boats) with very limited cruising range.

The information with respect to albacore fishing by the Washington-egon otter trawlers, also applies to the California otter trawlers.

In addition, a very limited number of fishing craft that ordinarily nfine their fishing activities to within the bays and rivers will sh for albacore whenever they approach close to the California coast.

The albacore fleet of southern California, including both those erating bait lines and those operating troll lines, also consists various types and sizes of vessels and boats, most of which engage other fisheries as well as albacore fishing. The other fisheries osecuted by the southern California albacore fleet are seining for lchards (sardines), mackerel, barracuda, miscellaneous small market shes, and bait; gill netting for sea bass, barracuda, shark, and her miscellaneous fishes, and trammel netting for California halibut; t line and hand line fishing for various market fishes; Pacific ckerel fishing with brails or scoop nets; swordfish harpooning; and shing for abalone with diving equipment.

A legal closed season is in force in California on sardines for nning or reduction purposes as mentioned earlier in this report but t for bait or other uses. Other fisheries having closed seasons e lobsters which are closed from April 16 through September 30, and alone which is closed from January 15, through March 15. Also rious other laws and regulations in all of the Pacific Coast States strict some fishing operations to certain areas within their spective jurisdiction, and may also restrict the sale of some species fish for certain purposes.

In recent years, albacore has been the major source of income to e southern California albacore fishermen, and even though perhaps t a majority, it does provide a very considerable portion of the nual income to many fishermen of the albacore fleet in northern lifornia, Oregon and Washington.

ARE THERE ENGINEERING IMPROVEMENTS WHICH CAN BRING ABOUT GREATER EFFICIENCIES IN FISHING OPERATION?

The marketing difficulties in the tuna industry and the related adverse economic conditions in the domestic tuna fleet which prevailed in 1951 have been previously referred to. Further evidence of the adverse conditions encountered by the bait boat fleet in particular is given in table 61. This table was originally prepared by the staff of the American Tunaboat Association, and submitted in evidence at the hearings on tuna imports held by the Senate Committee on Finance, February 4, 5, 6 and 7, 1952. Supplemental data for the year 1952 were added later. Corroborative evidence of the validity of the data in this table for the years 1950 and 1951 is given in table 67, prepared by the staff of the Service engaged in this study.

Regardless of the causes which contributed to the economic difficulties cited, it was determined in this survey to explore avenues of relief which might ameliorate the adverse effects of any cause of the economic difficulties encountered by the domestic tuna fleet. Improvements in the operating efficiency of the fleet was the theme of this particular work.

This particular approach is supported by evidence to the effect that the fisherman for his effort receives one of the larger shares of the consumer's payment for a can of tuna (see Chapter VII). The peculiar nature of certain types of tuna fishing such as the long trips of the clipper fleet and the low quantity of catch per unit of gear set in the albacore fishery make it a high unit cost fishing industry as compared to purse seining for pilchards or similar types of fishing. Moreover, the high cost element is evident in many foreign fisheries because of the great distances involved in capturing the roving tunas. It is obvious that all other things being equal the chances of making substantial savings in the cost of bringing canned tuna to consumers, who have so strongly evidenced that they like and want this product, should be greatest at the production level. In addition, any increased efficiency on the part of the domestic fisherman with resultant lower unit cost of production will make him better able to compete with foreign fishermen. Accordingly, the results of investigation in this field are given in this and the next section.

TABLE 61. - TUNA BAIT BOAT FLEET - INDEX OF ACTIVITY

(Total landings by fleet divided by capacity of all vessels for 1 full trip)

ar	Vessels surveyed	Potential tonnage	Actual landings	Activity index
46	86	12,945	47,867	3.70
47	120	23,175	69,933	3.02
48	137	27,345	89,606	3.28
49	153	32,845	92,822	2.83
50	172	36,710	121,807	3.32
51	183	38,785	101,114	2.60
52	178	41,065	102,915	2.51

urce: American Tunaboat Association.

Propulsion Units (Engines) and Propellers

The propulsion equipment in tuna vessels has reached a high gree of efficiency and reliability. The heavy duty slow speed esels have long been nationally recognized in the maritime industry r their dependability and economy, and as minor defects are disvered they have been rectified by the manufacturers. The introction of high speed main propulsion engines would result in duced weight, saving in space, and greater cargo capacity. The gh speed Diesel is becoming increasingly popular for service on nd, in smaller fishing vessels and for auxiliary service in the tuna eet. The greater uniformity of spare parts through mass production, atures of interchangeability and lighter weight which permit easier erhaul and repair are pertinent factors. As operating experience s developed it is quite possible that high speed Diesels will become pular in the tuna fleet.

One small school of thought among tuna boat builders is that the una vessel of today is too large, expensive, complex and costly to unction economically both as a catcher and carrier of tuna. This rgument is based on the fact that, although the clippers are nquestionably efficient in catching tuna, the cost of using them to eturn the catch several thousand miles to California ports is xtremely higher than the cost of cargo vessels would be. If the tuna fleet had been restricted to vessels of 100-ton capacity operating with motherships or some other form of cargo carriers, the tuna fishing operation might now be on a sounder economic basis. Smaller vessels with proportionately increased cargo capacity through the use of high speed Diesels may be an answer. However this must be considered against the background of mothership operations which have been tried with the practice being generally discontinued.

The use of Diesel-electric propulsion is under preliminary study because of greater flexibility of control, ease of handling, smooth propulsion, elimination of propulsion shaft alignment difficulties, and reduction of engine room space by combining the functions of the present main propulsion engines and the auxiliary engines used for electrical power service. The auxiliary engines and generators are highly efficient by modern engineering practice. The only fault may be inadequate capacity in some of the older vessels caused by the addition of new electrical loads for advance equipment.

Propellers have been installed on many thousands of fishing vessels and a great amount of design experience has been accumulated. As a consequence there appears to be little prospect of improvement in conventional propellers. Limited experience with variable pitch propellers has demonstrated that the control mechanism is subject to failure and that conventional propellers will result in equal or increased speeds of the vessel at a given power input.

Vessel Design

A tuna clipper is designed to carry the maximum load and the necessary mechanical and electrical equipment in the minimum overall length of hull. There are definite possibilities for improved hull design for easier running lines and seakindliness, but these designs are not compatible with maximum loads per foot of over-all length. The tuna vessel owners have decided that carrying capacity cannot be sacrificed for cleaner lines, desirable deadrise and flared bows. The cost of a hull is predicated on a relatively uniform price per foot of over-all length among builders for definite size ranges of vessels and types of construction. Essentially the buyer of a tuna boat is purchasing a definite number of tons carrying capacity for a fixed sum of money. Most fishing vessels are designed for the exploitation of specific fisheries with a specific type of gear. The tuna clipper is a highly-specialized type developed over many years and with the assumption that the resource is adequate to support such a highly specialized vessel throughout its useful life. Purse seiners, virtue of their large amount of free deck space aft are the most rsatile type of vessel in existence today, for they can operate rse seines, long lines, otter trawls, surface or submerged gill ts, and can even operate with pole and line gear for tuna in a nner similar to the tuna clipper. However, with the exception of rse seines, they cannot operate any of these types of gear as fectively as a vessel specifically designed for each purpose.

Because the bulk of the small-boat albacore fleet is seasonally pendent on other fisheries, there is little probability that there e major changes that could be made to increase albacore fishing ficiency that would not reduce efficiency in the other fisheries which the vessels engage.

Refrigeration Equipment

The ammonia compression system is nearly universal in the tuna eet. It has a high degree of reliability and effectiveness, and e primary fault might be lack of adequate reserve capacity in some stallations. Refrigeration was first introduced in tuna vessels out 1926, and since then constant engineering improvements have been de. The loss through spoilage is very low. Tuna vessel owners are tremely reluctant to experiment with other refrigerants or systems ich, if they do not function properly, could result in the spoilage cargo worth from $30,000 to $180,000, depending on the size of the ssel.

Compression Freon systems have been tried on tuna vessels but ey have been replaced with ammonia systems because of greater liability. Ammonia absorption systems hold promise, but the unvorable experiences reported to date with this system in some lmon freezer ships in Bristol Bay, has deterred its introduction the tuna fleet. The system as applied to fishing vessels still s serious imperfections in such items as liquor transfer pumps, d there is a general lack of engineers who can operate absorption stems. Theoretically the equipment and installation costs and the erating and maintenance costs are lower than those of compression stems. Theoretically, also, the absorption system has the vantage of maintaining greater efficiency at low temperatures than mpressor systems. However, these theoretical advantages do not tweigh the greater reliability of compressor systems in the mind the tuna vessel owner. It is also maintained that the lack of perienced operating engineers has hindered acceptance of the sorption system.

Pumps, Piping and Hydraulics

The pumps and piping system for bait water and brine circulation are highly efficient, but refinements providing greater versatility are being developed. The use of hydraulic pumps may be an innovation which could eliminate or greatly reduce the complicated electrical systems. Efforts are being made to develop plastic piping which would not be subject to corrosion, electrolysis or the attachment of marine growths.

Electronic Aids to Fishing and Navigation

New types of navigational equipment, such as loran (long-range navigation), radar (radio detecting and ranging), and the widespread use of supersonic depth recorders for locating schools of fish have materially increased fishery production in general since World War II. The continuous improvement of these devices and the development of new devices such as echo-ranging equipment, underwater listening equipment and electrical fishing apparatus will undoubtedly bring about greater efficiencies in fishing operations in the future with an attendant increase in fishery production. But a great amount of basic research is required before working sets of this advanced type of equipment can be made available to commercial fishermen. The extent to which these improvements and developments will increase fishery production is difficult to evaluate now, but it may be expected to be appreciable. A radical change in fishing methods such as the development of an electric fishing ship might revolutionize entirely commercial fishing operations as they are now carried out in certain fisheries.

Fishing vessels equipped with radar can operate with greater safety at night and during periods of poor visability. Tuna schools feeding near the surface are frequently accompanied by dense flocks of birds which can often be located more readily by radar than by the human eye. Loran has eliminated laborious computations formerly required to determine the vessels' position and has made possible the determination of position at any time during the day or night. Loran can materially reduce the man hours spent at sea by enabling the fisherman to place his vessel on a precise spot of a particular fishing bank in a minimum of time. Commercial fishermen in constantly growing numbers find the supersonic depth recorder very useful for locating schools of fish. Unfortunately, depth recorders have fundamental itations in that the fishing vessel must pass directly over the hool before receiving any indication of its presence. The depth orders now in common use are primarily designed for navigational poses and probably do not have the best frequency and wave aracteristics for locating fish. Research along these lines should eatly benefit the fishing industry.

The development of echo-ranging equipment similar to war-time nar(used for locating enemy submarines) but especially designed for cating schools of fish and reduced to a convenient size and reasonable st for use on fishing vessels would increase efficiency of operations. is known that certain fishes make characteristics noises, and this ndition may well pertain to tuna. The development of listening vices for receiving these sounds and thereby establishing the presence subsurface schools of tuna in an area would materially reduce the me required to find fish.

It is well established that fish will respond to an electrical imulus, and varying current densities can be used to influence the actions of fish in different size ranges. Such equipment is now used fresh water for scientific purposes. Experiments now being concted in Europe have demonstrated the possibility of controlling the vements of cod and herring in the open sea. The high conductivity sea water requires far greater amounts of electrical power than esh water to control the reaction of fish. Pulsating, rather than ntinuous, current will materially reduce the electrical power requirents and offers promise of practical electrical fishing methods at sea. tensive basic research is required to establish proper pulsation tterns, to design proper and safe equipment and to test the equipment der actual operating conditions. The successful development of ectrical fishing devices may revolutionize the fishing industry as lected species and sizes of fish could be attracted to a net for apture or even pumped aboard the vessel.

Fishing Gear

The various types of tuna fishing gear have attained their present tate of effectiveness through the concerted efforts and ideas of many housands of practical fishermen over a period of many years, to best uit the species of tuna and the area exploited. Furthermore, the ishermen have become highly skilled in the operation of the gear and n studying the habits of tuna to use the gear most effectively. Any change in fishing methods must prove of decided superiority over existing techniques on an actual production basis. Minor improvements are being introduced by fishermen, and radical types of gear are being tested by various Governmental research agencies.

The only improvement made in purse seines during the past five years is the use of chain to replace lead lines. A cheap grade of linen netting was used experimentally in 1950 in the hope of making a lighter and stronger seine but the material would not stand up. High grades of linen are too expensive to compete with cotton as netting material for tuna seines. The life of a tuna seine is relatively short because of deterioration in the tropics and the distortion of the netting due to the heavy catches. It is possible that plastic or nylon netting may prove superior to cotton but no testing program is in existence now as far as can be determined.

Results of experimental gill netting for albacore by the Service vessel *John N. Cobb* in 1950 were encouraging (Powell, Alverson and Livingstone, 1952), but the poor runs of albacore in the Pacific Northwest the following two years prevented further large-scale experiments with gill nets. Trials of gill nets in Hawaiian waters by the Pacific Oceanic Fisheries Investigation met with little success in catching tuna. This was believed to be at least partly due to the extremely clear water in the area. It has not been demonstrated as yet that gill nets will catch any species of tuna as consistently or efficiently as the standard types of gear now in use. Perhaps gill nets may be used as auxiliary gear which can be set while the tuna boat is drifting at night. Overall catches might be increased in this manner, but at the moment there is no indication that gill netting will replace any other gear or will be used exclusively by any tuna boats.

Long-line gear, developed and used extensively by Japanese tuna fishermen, has been under test by the Pacific Oceanic Fishery Investigations staff of the Fish and Wildlife Service in the central Pacific for several years. These tests have proved that tuna can be taken with long line over a wide area of Pacific equatorial waters at rates as good or better than prevail in the Japanese tuna fishery. An experiment with a Pacific coast purse seiner, the *Cavalieri*, using long-line gear, was successful in taking a full load of tuna. However, the fish were of large size, and much of the catch was discarded because of discoloration. Long line has certain advantages over other gear in that no live bait is needed, it can be handled in weather too rough for seining, and it does not require surface observation of the school as te gear can be fished at various depths. Its main disadvantage i probably the amount of man-power needed to handle it. There ae definite possibilities for improving the gear to make it esier to handle and more efficient in operation. If it can be sown that this method of fishing can be profitably carried out to American fishermen and vessels, new offshore fishing areas can b opened, which may be an answer to part of the present problems fced by the tuna industry.

Over-all Considerations

In exploring means of improvement in vessel design, machiery, and use of fishing gear, constant attention has been given to improvements which would result in reduction in size of fishig crews. The manpower element is of paramount importance because of its major bearing on the actual cost of production of the raw material. Under present circumstances, however, it is believed that the tuna fleet is composed of craft on which little improvement can be made to increase present efficiency in production. Probably no great change toward more effectiveness per unit of crew effort and resulting curtailment of production cost will come until some revolutionary means of catching tuna can be applied in a practical manner.

THE IMPORTANCE OF BAIT, ITS COST, AND OUTLOOK FOR IMPROVEMENTS IN MAKING BAIT

The catching of bait is important and costly in the operaion of the domestic tuna fleet. There are two methods of demontrating the importance and necessity of bait to the tuna industry. ne is to evaluate the production of raw tuna by United States veseels, both as to weight and value, by use of the live-bait method f fishing as contrasted with similar production and value by use f other fishing methods. The second is to show the time, the rouble, and the expense United States vessels must undergo to seure bait. The importance and necessity of bait will be considerd and analyzed from both of these standpoints. In addition, rospects of improvement in the process of making bait will be onsidered.

Quantity of Tuna Caught with Bait

Albacore, highly variable in abundance, 9/ constituted 18 percent of the total landings of tuna by weight by domestic vessels and 22 percent of the value in 1950 10/ on the United States Pacific coast (see table 62). In addition to representing a relatively small percentage of the Pacific coast tuna landings, albacore is subject to a high degree of fluctuation in yearly catches.

On the other hand, skipjack and yellowfin, tropical tunas, constituted 80 percent of the weight and 76 percent of the value of similar landings in 1950. Equally as important, skipjack and yellowfin do not possess the seasonality or wide swings in yearly abundance as in the case of albacore 11/. Because of the factors of quantity and dependability, skipjack and yellowfin together form the backbone of the United States tuna fishing industry.

9/ During the 21 years from 1927 through 1947, the landings of albacore by the California fleet in any one year varied from a low of 487 pounds to a high of 21,000,000 pounds (California Department of Fish and Game, 1949). In 1950 at San Diego albacore were landed in only 7 of the year's months, and the bulk of the landings were in the 4 months July through October (California Department of Fish and Game, 1952).

10/ The year 1950 has been selected for reference and discussion purposes, since in 1951 extensive fleet tie-ups occurred because of industry economic factors and 1952 figures are not complete at the time of this report.

11/ In 1950 at San Diego in each month of the year, landings of skipjack and yellowfin occurred in fairly regular and consistent amount (California Department of Fish and Game, 1952). During the period of 1927 to 1947, although fluctuations occurred in the landings of yellowfin and skipjack by the California fleet, these were much less pronounced than in the case of albacore (California Department of Fish and Game, 1949)

ABLE 62. - CATCH OF TUNA AND TUNALIKE FISHES, PACIFIC COAST STATES BY SPECIES AND GEAR - 1950

ecies	Gear	Weight	Portion of total	Value	Portion of total
		Pounds	Percent	Dollars	Percent
bacore	Lines	72,406,700	18.38	13,833,711	22.46
	Purse seine	7,900	-	1,493	-
	Total	72,414,600	18.38	13,835,204	22.46
uefin	Lines	39,500	.01	6,011	.01
	Purse seine	2,722,300	.69	419,380	.68
	Total	2,761,800	.70	425,391	.69
nito	Lines	197,500	.05	19,352	.03
	Purse seine	1/498,100	1/.13	1/48,351	1/.08
	Total	695,600	.18	67,703	.11
ipjack	Lines	114,911,300	29.16	16,481,331	26.76
	Purse seine	11,874,800	3.01	1,649,108	2.68
	Total	126,786,100	32.17	18,130,439	29.44
llowfin	Lines	148,210,800	37.61	22,883,237	37.15
	Purse seine	39,678,700	10.07	5,939,976	9.64
	Total	187,889,500	47.68	28,823,213	46.79
llowtail	Lines	1,408,100	.35	128,644	.21
	Purse seine	2/2,121,700	2/.54	2/185,690	2/.30
	Total	3,529,800	.89	314,334	.51
COMBINED TOTALS		394,077,400	100.00	61,596,284	100.00

/ Includes 3,300 pounds caught by gill nets - value $328.

/ Includes 1,300 pounds caught by gill nets - value $114.

Bait is essential for the skipjack-yellowfin fishery, and the albacore fishery also requires a large amount. For example, 82 percent of the skipjack-yellowfin catch by the California fleet in 1950 was made with bait (see table 63). It is conservatively estimated that at least 70 percent of the entire tuna catch (all varieties of tuna) made by the United States fleet in the eastern Pacific is taken with bait.[12] This method of fishing for tuna is very efficient from the standpoint of production per man day.

TABLE 63.[1] - YELLOWFIN AND SKIPJACK [2]
LANDED IN CALIFORNIA, 1948 - 1950

	Tuna Bait Boats		Purse Seiners	
YEAR	Number of craft	Pounds (percentage of total)	Number of craft	Pounds (percentage of total)
1948	171	199,891,149 (77.28)	111	47,089,076 (18.21)
1949	182	222,286,771 (84.59)	108	31,381,001 (11.94)
1950	193	251,831,713 (82.13)	115	51,633,050 (16.84)

(continued on next page)

See footnotes at end of table.

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[12] Exact figures for the weight of other tunas, chiefly albacore, taken with bait are not available. Taking the known catch of yellowfin and skipjack with bait (table 62) and assuming one-third of the total catch of albacore (table 61) was caught with bait, it is estimated that at least 70 percent of the total Pacific coast tuna catch in 1950 (table 61) was made with bait.

TABLE 63.1/ - YELLOWFIN AND SKIPJACK 2/
LANDED IN CALIFORNIA, 1948 - 1950 - Continued

ear	Miscellaneous		Yearly Totals	
	Number of craft	Pounds (percentage of total)	Number of craft	Pounds (percentage of total)
48	700	11,658,397 (4.51)	982	258,638,622 (100.00)
49	515	9,124,415 (3.47)	805	262,792,187 (100.00)
50	282	3,162,374 (1.03)	590	306,627,137 (100.00)

1/ This material is a continuation for subsequent years of
ble 3 of the California Department of Fish and Game, Fish Bulletin
. 74, The Commercial Fish Catch of California for the Year 1947,
th an historical review 1916 - 1947, furnished through the
urtesy of the California Department of Fish and Game.

2/ The catch of yellowfin and skipjack combined made by the
lifornia fleet of boats, broken down into: (1) tuna bait boats,
ose that fished throughout the year or a great part of it; (2)
gular purse-seiners; and (3) miscellaneous smaller craft which
shed only at the northern range of the tuna, with any type of
ar, nets, or live bait.

Cost of Bait

A few of the costs of securing bait are direct costs which can
identified, but most of them are merged so completely with other
nctions of tuna fishing and boat operations that they cannot be
olated. Conversations with tuna boat operators reveal that cost
gures on the baiting activity have never been kept by the vessels,
d there is doubt as to the practicability of ever obtaining such
gures.

NETS AND BOATS

Bait nets are a direct cost which can definitely be ascribed to securing bait. The requirements and the cost of these are detailed in table 64. These nets are used to catch bait, and depending on the size of the fishing vessel and its area of operations, may cost from $3,000 to $7,000 in round figures. The life of these nets is normally about a year. To fish these nets the tuna vessel carries a speedboat, a large skiff, and a small skiff, having an aggregate cost of around $4,000. However, it is probable that at least some of these boats would be necessary equipment even if not used for bait procurement.

FOREIGN LICENSES

Another type of cost which is fairly direct is the cost of foreign licenses and permits (see table 65). Since these licenses grant the privilege of fishing for tuna as well as for bait, for example both tuna and bait are taken close to land at the Galapagos Islands, it is not always possible to segregate the portion of the

TABLE 64. - BAIT NETS USED BY TUNA FISHING VESSELS 1/

Number and type of nets	Cost	Length	Depth	Mesh size	Twine
Two small sardine	$1,000.00 ea.	102 fthm.	15 fthm.	(a) Bag ½" (b) Apron 3" (c) Wing 6"	26 cable #6 thread #6 thread
One large sardine	$1,300.00 ea.	130 fthm.	20 fthm.	(a) Bag ½" (b) Apron 3" (c) Wing 6"	26 cable #6 thread #6 thread
One anchovetta	$1,000.00 ea.	102 fthm.	14 fthm.	(a) Bag 3/4" (b) Apron 3" (c) Wing 6"	29 cable #6 thread #6 thread
One small Galapagos	$1,500.00 ea.	68 fthm.	7 fthm.	(a) Bag 7/8" (b) Apron 1" (c) Wing 1"	#6 thread #6 thread #6 thread
One large Galapagos	$1,800.00 ea.	80 fthm.	10 fthm.	(a) Bag 7/8" (b) Apron 1" (c) Wing 1"	#6 thread #6 thread #6 thread

1/ Information furnished by owner-captain of a tuna clipper, November 1952. Average life of net aboard an average tuna vessel is approximately one (1) year. Part or all of the nets listed above may be carried on a tuna clipper, depending on its size and range of operations.

st which should be allocated to bait. An examination of the table ill show that the licensing charges are costly. A vessel of 200 t tons, for example, would pay over $2,000 (U. S.) for a 90-day xican fishing license alone, not counting additional fees for an-al registration, bait seines, and crew-members' personal licenses. A Ecuadoran license for the same size vessel, good for 100 days, uld cost $2,400 (U.S.), plus an additional charge for annual gistration. Other countries have varying charges as shown in the ble. Some boats use more than one country's license on a trip. e American Tunaboat Association has furnished an estimate that the st of Mexican licenses for its members approximates $13 per ton of na caught by the vessels with the licenses, but similar information ncerning the over-all cost of foreign licenses is not available. is impossible to be completely categorical as to the particular reign licenses taken by various boats, but in general, these are follows: Small boats (100-ton carrying capacity or less) take a xican license, medium boats (more than 100 tons up to 200 tons) ually take a Mexican license, and large boats (over 200 tons) requently take a license in Mexico, Ecuador, Panama, or other ountries.

TIME FACTOR IN BAIT PROCUREMENT

Although other costs undoubtedly exist, they must be shown in different way. There is, for example, a material cost of time in e baiting activity. In the absence of published data the time actor for the baiting activity has been estimated according to the ollowing method of samplings. Information was obtained from 13 essels in the San Diego bait fleet selected to give a cross-section f the three size groups (100 tons capacity or less, more than 100 o 200 tons, and over 200 tons) which shows that an average of 17 ercent of these vessels' time at sea in the year 1952[1] was devoted o securing bait. Variations for individual boats ranged from 9 percent to 33 percent, with nearly all within the range of 12 percent o 20 percent.

Assuming that the figure of 17 percent baiting time is typical or an average year, the number of days at sea devoted to taking bait ay be calculated as follows. Records for a typical number of bait boats n each size class for 1950 reveal that an average of 256 days per vessel ere spent at sea in that year. Thus the average baiting time per vessel ould be 44 days per year.

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[1] 1952 data used in absence of any other.

TABLE 65. - ABSTRACT OF FOREIGN FISHING LICENSE INFORMATION FOR MAJOR TUNA BAIT AREAS

MEXICO (as of November 15, 1952)

Vess. Reg. Tons	Days Good For or Time Good For	Cost in Mexican Pesos, per Net Reg. Ton. of Vessel
Bait and fishing license		
1 to 3 incl.	10	55.73
4 to 15 incl.	25	133.76
16 to 70 incl.	50	144.91
71 to 100 incl.	70	89.18
101 and over	90	89.18
101 and over only	Special winter rate, Nov. 16 - Feb. 19	55.73
Annual boat registration		
All tonnages	1 year from issue date	5.70

Other

Net registration (all nets including bait nets) $0.21 Mexican per meter measured on the corkline. Good for one year from issue date.

Personal fishing license. $4.00 Mexican for each member of the crew. Expires December 31, each year.

Notes

Tonnage is basis net ton registry as per U. S. Customs admeasurement for the vessel. Current effective rate of exchange at Ensenada, Mexico, is $8.50 Mexican equals $1.00 U. S. Ensenada is the only Mexican port at which U. S. vessels can secure licenses in Mexico. Most of these licenses are actually purchased in San Diego or San Pedro, California, where 25 percent additional is charged. Official rate of exchange, $8.65 Mexican equals $1.00 U. S., applies in San Diego and San Pedro.

(Continued on next page.)

BLE 65. - ABSTRACT OF FOREIGN FISHING LICENSE INFORMATION FOR MAJOR TUNA BOAT AREAS - Continued

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OSTA RICA (as of November 15, 1952)

Annual matriculation (registration) equivalent to a permit, alid from date of its issuance, according to the following ariff:

Gross ton of vessel	Rate per vessel $U.S.
Up to 25	$150.00
26 to 50	200.00
51 to 100	300.00
101 to 150	350.00
More than 150	500.00

ANAMA (as of December 22, 1952)

License valid for season of year in which purchased. Bait ishing season is from February 15 to October 15.

Net tons of vessel	Rate per vessel $ U.S. 1/
Under 25	Up to 375
Over 25 and up to 50	390 to 750
Over 50 and up to 100	765 to 1,500
Over 100 and up to 150	1,515 to 2,250
Over 150 and up to 200	2,265 to 3,000
Over 200	3,015 and up

ther

Personal fishing stamp - $1.00 for each crew member. All essels receiving licenses must purchase their fuel, supplies, nd lubricants, and make their repairs in Panama.

(Continued on next page.)

/See footnote at end of table.

TABLE 65. - ABSTRACT OF FOREIGN FISHING LICENSE INFORMATION FOR MAJOR TUNA BAIT AREAS - Continued

ECUADOR (as of November 15, 1952)

Document required	Good for	Cost $ U. S.
Registration (Matricula)	1 calendar year, expires Dec. 31, each year	$200.00 per boat
Fishing license	100 days. One renewal permitted	$12.00 per registry net tonnage of vessel
Consular fees:		
Certification of bill of health		$15.00 per application
Certification of crew list		$ 0.10 per man

Note

Matricula and license not valid in continental Ecuadoran waters.

1/ Calculated on basis of $15.00 U.S. per net ton of vessel.

Quantity of Bait Used

Although 70 percent of the domestic tuna catch is estimated to be made by the use of bait, only 10 to 15 percent of all the bait needed or used is taken in United States waters and this portion is suitable only for use in the so-called "local" fishery (California-Mexico grounds). The remaining 85 to 90 percent of the bait requirement comes from foreign waters. The operating range of United States tuna bait vessels is shown in table 66.

TABLE 66. - OPERATING RANGE OF UNITED STATES TUNA BAIT VESSELS

ipacity (Tons)	Number of Vessels	Operating Range 1/
)0 or less	30	Gulf of Tehuantepac
ore than 100 to 200	79	Costa Rica
ver 200	112	Peru

/ Means vessels fish the high seas to as far as the geographic eferences given. They also fish seaward up to 250 - 300 miles ithin this range.

Records of the total amount of bait used to catch tuna are navailable, although such studies are presently underway. In the bsence of appropriate statistics, it has been estimated that in the ear 1950 the United States fleet used more than 26,000,000 pounds f bait. Of this amount it is estimated that only 3,000,000 pounds as taken from United States waters. The amount of bait actually sed does not necessarily correspond with the amount needed, since nen bait is in good supply it is used liberally and when in short upply, frugally.

The basis of this estimate follows. Fishermen use "scoops" s a unit for counting bait. (A dip net is used to transfer bait ish from the bait net to the tuna boats' bait tanks. Each dip net oad is counted as a "scoop.") According to a former Fish and ildlife Service official who studied the matter, a "scoop" will verage about 10 pounds of bait fish and an average of about 20 scoops" of bait are used to catch one ton of yellowfin or skipjack with considerable individual variations from average due to season, vailability, and biting habits of the tuna). This yields a 1-ound-of-bait to 10-pounds-of-tuna ratio for the skipjack and the ellowfin caught by the bait fleet. Live bait is also frequently sed in the albacore fishery, but they are also taken in large mounts without the use of bait. Statistics are not available to ccurately segregate the amount of albacore taken with bait. It as been assumed here that one-third of the total albacore landings re fish caught with the use of bait and that the amount of bait needed to catch a given weight of albacore is half that needed to catch the same weight of yellowfin and skipjack. (These estimates were derived from conversations with albacore fishermen in the harbor of San Diego.) On these assumptions, the bait-catch ratio for the entire albacore landings would be 1 pound of bait to 60 pounds of albacore.

The availability of bait and the amount used undoubtedly varies from year to year depending on fishing conditions. In considering the estimated bait consumption for 1950, it should be kept in mind that a record tuna catch was produced in that year and that production by the United States fleet has declined in succeeding years.

Types of Bait and Where Found

The volume of bait indicated is composed of several species of bait fishes, which are found in various geographic locations. The principal bait varieties commonly used are as follows:

Anchovetas (Cetengraulis mysticetus). This bait is preferred by tuna fishermen for long hauls because of its hardiness and ability to withstand crowding in the bait tanks. It will live in all water temperatures encountered in the clipper fleet tuna fishing range, and will live 2 or 3 months if care is taken to avoid abrupt temperature changes. Anchovetas are found along the Lower California coast, the Gulf of California from the vicinity of Guaymas southward along the coast of Mexico, the Gulf of Fonseca, and the Gulf of Panama. They also occur on the Columbia coast, where they are not extensively utilized and reportedly are of inferior survival quality. In 1950 and 1951 they were taken in the Gulf of Guayaquil, but Ecuador has now closed this area to foreign boats.

California sardines (Sardinops caerulea). These are superior to anchovetas from the standpoint of attracting and chumming tuna, but will not crowd as well as anchovetas in the bait tanks. California sardines are unsuitable for southern trips as they will not survive the warmer water. In the winter they may be transported to the Galapagos region by steering an outside course in colder water. They are never satisfactory to transport to Central or South America. They are found along the coast of California from the vicinity of San Pedro to the California-Mexico boundary and in Mexican waters on the Lower California coast and in the Gulf of California.

Northern anchovies (*Engraulis mordax*). These are not as hardy as chovetas. They are taken in the same places and used in the same nner as California sardines.

Salimas (composed of two species of the family *Xenichthyidae*). ey are a hardy bait, taken only at the Galapagos Islands and used ere.

Peruvian sardines (*Sardinops sagax*). This bait has characteristics milar to California sardines. It is taken by the United States fleet ly at the Galapagos Islands and used there.

Other bait varieties not commonly used are as follows:

Thread herring (*Opisthonema libertate*). Small thread herring are ite hardy; large ones, less so. They are used when other bait is ot readily available. They are found from Lower California to Central erica and off the southern coast of California.

Flat-iron herring (*Ilisha furthi*). This bait does not survive ll in bait tanks. It is used when the fishing grounds are nearby d other baits are not available. It is found from Lower California Central America.

Foreign Bait Regulations

Some of the foreign countries which possess bait supplies en- orce regulations as to the baiting areas (see table 65). These ange from partial and seasonal closures as in Panama to complete rohibition of foreign fishing as in Peru. Such closures, of course, ave their effect on the availability of bait to American vessels. exico, a major source of bait supply, licenses American vessels to ake bait in her waters without seasonal limitations. As in most isheries the bait supply in Mexico is subject to temporary natural luctuation, but Mexico constitutes a dependable source of supply at e present time. Panama enforces a seasonal closing in the Gulf of anama from October 15 to February 15 each year, as well as a ermanently closed area in Panama Bay. During the closed season, a ource of bait for bait boats fishing the highseas grounds off Peru s lacking. The bait situation for the long range boats is aggra- ated by the fact that Ecuador closed the Gulf of Guayaquil in anuary 1952 to American boats, thus making this bait location no onger available to American boats. Disappearance of the anchovetas from Costa Rice (the Gulf of Nicoya) in 1948, said to be due to a natural disaster, a "red tide", removed at least temporarily this abundant supply of bait from the tuna fleet.

Bait Supply Situation

In general bait supplies during 1951 and 1952 have been adequate for the United States tuna fleet. A good many of the bait species are known to fluctuate widely at various times and places. There have been times, it is true, when boats have been materially delayed for lack of bait. As an example of natural fluctuating supply, there is the sardine situation in the Galapagos Islands. In the 1950-51 season sardines were plentiful; in 1951-52 they were scarce; and to date in the 1952-53 season, plentiful. Similar occurrences may be found in other baiting areas.

While the physical supply of bait has been adequate, the inconvenience and uncertainty occasioned by foreign control of the supply must be recognized. With some countries such as Mexico, arrangements exist to the mutual satisfaction of the foreign country and the American tuna fleet. In other countries, there are partial or complete closures of baiting grounds and sometimes sudden unanticipated closures. In addition, there are involved the matters of licenses and fees in order to obtain bait. Sometimes the problem of securing physical possession of the necessary foreign license causes considerable inconvenience to United States vessels. At the present time it appears that smoothing out the international complications concerning utilization by the United States fleet of available foreign bait in a manner mutually satisfactory and beneficial to the foreign countries and the United States is relatively more important than the matter of physical availability of bait.

Future Problems and Bait Research

Aside from the matter of international relations mentioned above, such questions as these await answers in the future: The amount of fishing pressure which the various bait stocks can withstand and the degree of bait fishing intensity that can be tolerated without introducing the problem of overfishing. Present knowledge provides no answers to such questions.

PRESENT BAIT RESEARCH--NATURAL BAIT

The Inter-American Tropical Tuna Commission, at present adhered by Costa Rica and the United States, with research headquarters at Diego, is undertaking research on the biology, ecology, and distri- ion of the tropical bait fishes. This agency is now collecting t samples from some of the tuna boats upon their arrival at San go. At the present time the research is in the preliminary stages. ag for bait fish to assist in studying migrations and other matters been developed.

California sardines, in addition to being valuable for food and h meal, fish oil and condensed fish solubles, are an important bait h. The sardine investigations, conducted cooperatively by the ifornia Academy of Sciences, California Department of Fish and Game, nford University (Hopkins Marine Station), the Fish and Wildlife rvice, and the University of California (Scripps Institution of anography) may be of value also from the standpoint of bait re- rch.

In Peru, under the auspices of the Peruvian Division of Fish and e and the Guano Company, there is research being conducted concerning logical aspects of the anchovy. The relationship of anchovies to substance known as "guano" is the purpose of this work, but it may ve indirect value towards bait research because anchovies are one of bait fishes.

PRESENT BAIT RESEARCH--SYNTHETIC BAIT

The American Tunaboat Association under the direction of its search director has developed a synthetic minnow made of porous astic. This plastic is capable of absorbing liquids. At the present me the plastic minnows cost ten cents each to produce, but with mass oduction the price might be as low as two cents each, at which price ey might be economically feasible, according to the research director.

The Pacific Oceanic Fishery Investigations staff in cooperation th the University of Hawaii has conducted experiments as to the eding reactions of certain captive tuna. An as-yet-unidentified bstance in the dark flesh and blood of tuna, when introduced into the ter, appears to create a feeding reaction in the tuna. The feeding sts were conducted in ponds at Coconut Island, T. H.

There is a possibility that by impregnating a plastic minnow with a fluid containing a feeding reaction agent, an artificial bait might result. These experiments are still in the preliminary phase and it is too early to attempt to forecast their outcome.

CAN BAIT RESEARCH (NATURAL AND SYNTHETIC) DEVELOP A MEANS TO EXPEDITE OPERATIONS AND REDUCE COSTS OF PRODUCTION?

It is clear from the preceding discussion that bait at the present time is expensive from both financial and time standpoints and that the supply is largely controlled by foreign countries. It is obvious that a substitute source of bait would be desirable and encouraging results in preliminary research have been obtained recently. Success in such research would expedite operations through time savings and would reduce costs by eliminating various license charges and equipment costs. Moreover, it would free the high-seas fleet from dependence on foreign-owned bait.

At the present time little is known about potential bait fishes in the open ocean — where they are, how suitable they are for chumming purposes, how well they would survive in bait tanks, how deep they are, how plentiful they are, how dependable their occurrence is, or how they may be caught. Occasionally a catch of bait is taken quite far from any land. It has been reported that from time to time bait has been caught on the high seas off Panama and as far as 60 miles off the coast of Peru. Rather extensive investigation of these matters would need to be undertaken to ascertain if such a source could possibly substitute for the immense weight of bait fish needed by the fleet each year.

Synthetic bait, if perfected and available at reasonable cost, would possibly be even more desirable than a substitute supply of natural bait. A synthetic bait would not be perishable, could be procured and stored on board like any other fishing supply, would require no expensive water-circulating system to keep the bait alive, and would free the fishing vessel from dependence on baiting areas with the attendant delays to fishing. However, to develop such a synthetic bait would undoubtedly require sustained research and experimentation. To the present time, only live natural bait has proved successful in the tropical fishery. To be acceptable, an artificial bait would have to do as good a job as the present live

. Because of the high cost of vessels and the large trip nses, a bait vessel cannot reply on anything but a successful .

There appears to be little immediate prospect of materially ucing bait costs or over-all costs of fishing in the tuna ustry. Although the outlook was bleak in this respect, it was ught that the tuna boat operators financial and economic position ht still be buttressed by looking for alternative sources of ome. Such things as use of tuna craft in other fisheries, nsport trade, and mothership operation together with changing n fishing activity from present operating ports were thought of. se possibilities were considered and they are discussed in the t two sections.

TUNA FLEET PARTICIPATION IN OTHER FISHERIES, OR TRANSPORT TRADE

To gauge the amount of reduction in fishing effort by the or segment of the domestic fleet, the fishing records of 25 ical tuna bait vessels, each of more than 200-ton carrying acity, were analyzed for the years 1950 and 1951. The analysis eals that, compared with 1950, fishing activity for these vessels reased in 1951 as follows: number of trips per year, 30 percent; s at sea, 33 percent; and tons of tuna caught, 26 percent. This ormation is shown in table 67. The decline in fishing activity, h the attendant lower earnings for the vessels, made alternate loyment for these vessels a subject of interest.

Possibility of Engaging in the Pacific Coast Trawl Fishery

Table 68 supplies comparative data for the Pacific coast tuna hery and the Pacific coast trawl fishery. This comparison indi- es that the trawl fishery amounts to only 23 percent of the tuna hery in terms of weight of fish landed, and to only 7 percent in ms of value of landings. Trawl fish are worth less than one-third much per pound as tuna. These comparisons indicate that the trawl hery lacks the necessary potential to serve as an outlet for idle a vessels.

Moreover, Pacific coast trawlers are themselves confronted with keting problems. They have been required to endure restrictions in

TABLE 67. - COMPARATIVE INFORMATION CONCERNING 25 VESSELS IN THE TUNA BAIT FLEET, HAVING CARRYING CAPACITIES OF MORE THAN 200 TONS, FOR THE CALENDAR YEARS 1950 AND 1951

Year	Trips		Trip Days		Tuna Caught			
	Total	Av. per boat	Total	Av. per trip	Total	Per boat	Per trip	Per day
	Number	Number	Number	Number	Tons	Tons	Tons	Tons
1950	98	3.92	6,739	68.76	28,682	1,147	293	4.26
1951	69	2.76	4,500	65.22	21,324	853	309	4.74

TABLE 68. - COMPARATIVE LANDINGS OF TUNA AND TUNALIKE FISHES, AND TRAWL-CAUGHT FISH - PACIFIC COAST STATES - 1950

Fishery	Weight Landed	Relation To Tuna Weight	Value	Relation To Tuna Value
	Pounds	Percent	Dollars	Percent
Tuna and tunalike fishes	394,077,400	100.00	61,596,284	100.00
Trawl-caught	88,724,000	22.51	4,148,617	6.73

ir fishing efforts becuase of a poor market. Trawlers, as a rule,
e been curtailed as to the amount of fish they can land by market
itations. The existing trawl fleet appears capable of supplying
sent demand for trawl fish on the Pacific coast.

Of the tuna vessels, seiners are most suitable for conversion to
rwling. Most of these vessels are based at San Pedro. The General
ager of the Fishermen's Cooperative Association of San Pedro which
resents the majority of these vessels, is of the opinion that trawl-
n offers no promise for these vessels. He reported that a few of the
sels have tried trawling with mediocre results. In his opinion,
se vessels need something new to fish for in place of the scarce
ifornia sardines (numerous California seine boats divide their year
ween the tuna and the sardine fisheries as has been previously indi-
ed).

Possibility of Engaging In The Alaska Salmon Freezer-Ship Industry

EXPERIENCE AND FUTURE POSSIBILITIES

In recent years freezer-ships have operated in ever-increasing
bers in the Bristol Bay Area of Alaska. These ships carry smaller
ts (gill netters) which are used as catcher boats. The gill netters
iver their salmon catches to the freezer-ships, where they are
zen whole. Eventually the freezer-ships return to one of several
et Sound ports and discharge their cargo of frozen salmon. The frozen
mon are then canned. Red salmon is the variety most sought by the
ezer-ships. However, in 1952 some of the vessels also took pink and
m salmon. Whether the freezing of pink and chum salmon will prove to
feasible and profitable is as yet unknown. The freezer-ship indus-
has been concentrated mainly in the Bristol Bay Region of Alaska,
Territory's chief source of red salmon. Freezer-ship growth in
stol Bay is indicated in Table 69.

Table 69.- TAKE OF SALMON BY FREEZER-SHIPS IN BRISTOL BAY, ALASKA

Year	Fish Caught Total for Area	 By Freezer-ships	Portion of Total By Freezer-ships	Freezer-ships in Operation
	Pounds	Pounds	Percent	Number
1950	44,519,956	1,016,130	2.28	5
1951	24,590,922	2,994,828	12.18	11
1952	68,788,896	9,306,234	13.53	17 [1]

[1] These vessels fished 129 gill-net boats with an aggregate of 19,350 fathoms of gill nets.

Freezer-ships have increased rather rapidly in number in recent years, and in 1952 they accounted for approximately 14 percent of the salmon taken in Bristol Bay. They also accounted for an unknown, but small, portion of the take from other areas of Alaska.

Numerous economic factors make it impossible to forecast the future of the freezer-ship industry. Some of these factors are: cost of raw salmon; cost of vessel operations including payroll; policies and cost of production of competitive shore-based canneries; selling price of canned salmon; and consumer acceptance of the freezer-ship canned-salmon product.

The theoretical limitation upon freezer-ship expansion is the portion of the fish supply which is not as yet taken by the freezer-ships. In the Bristol Bay Area 86 percent of the catch was taken by other methods. If freezing proves successful with pink and chum salmon, the theoretical potential for freezer-ships would be much greater.[14] To take care of a great volume of frozen salmon from Alaska, no doubt canning facilities in the Puget Sound or other continental United States areas would require expansion.

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[14] In 1951, the Alaska salmon take amounted to 276,588,312 pounds of which 113,666,596 pounds were pink salmon. Other species of salmon were taken as follows: Chum, 52,934,320 pounds; Coho, 36,279,648 pounds; King, 15,790,840 pounds; Red, 57,916,908 pounds.

It is of course unlikely that the existing Alaska shore plants would
t their fish supply to be diverted by freezer-ships without offering
uous competition to retain their supply, or that the residents and
overnment of the Territory will surrender without protest the import-
anned salmon industry 15/.

STRUCTURAL MODIFICATIONS FOR TUNA VESSELS IN THE SALMON-FREEZING TRADE

Of the 17 freezer-ships which operated in Alaska in 1952, 6 are known
tuna vessels. Tuna vessels require only a moderate amount of con-
on to become salmon freezer-ships because they already possess refrig-
ion and large frozen carrying capacity. The method of freezing used
ally by tuna vessels (brine-freezing) has also been adopted by other
s of vessels in the salmon freezer-ship industry. Tuna vessels require
rations mainly to permit carrying the catcher boats and to provide gas-
e storage for the catcher boats and living accommodations for the
ermen who man the catcher boats. For a tuna vessel using 8 to 10 catcher
s, these modifications are estimated to cost between $4,000 and $6,000
nding on the particular vessel.

Tuna vessels have as much carrying capacity for frozen salmon as they
for tuna. If salmon are received at a fast enough rate to permit load-
a complete brine well at a time, the brine may be drained off the salmon
oon as they are frozen and the salmon left in that well for dry storage.
ver, if fish are received at a slow rate, it is necessary to transfer them
r they are frozen to another well for dry storage. Since the fish assume
orted positions when frozen, they do not stack in the best space-
erving manner when transferred to another well. Tuna vessels appear to
demonstrated that they are practicable in the freezer-ship industry
salmon so far as receiving and freezing salmon is concerned.

Total 1951 Alaska salmon pack was 3,484,468 cases (48 1-pound cans)
ed at $79,249,185. Western Alaska pack was 388,519 cases valued at
859,298. In 1951 the entire Alaska salmon fishing industry employed
25 persons who earned $17,114,315. In western Alaska 6,064 persons
ed $3,605,475.

OPERATING COSTS

No basis exists for providing comparison between operating costs of tuna vessels in the tuna fishery and in the frozen-salmon industry. This is because in the first instance the vessel operates as a fishing vessel with all crew members working on a share basis, that is, sharing in the profits and the expenses of the fishing venture. In the second instance the vessel operates as a factory ship, and the owner alone assumes the financial risks. He pays the crew, pays all expenses of the voyage, and buys at prevailing prices the fish received by the vessel; and his profit, if any, is the difference between the total operating costs and the gross income from the voyage. It is possible for him to lose a large sum of money if the voyage proves a failure. By having the salmon custom-canned for his account he assumes a further risk since he then speculates as well in the canned-salmon market.

Both the gill nets and the gill-net boats are furnished by the vessel owner. Gill nets to outfit one catcher boat cost $500. These have a life of 1 year for the web and 3 years for the cork and lead lines. The gill-net boats cost $6,000 to $7,000 each and have a life of 5 years. Assuming a fleet of eight catcher boats, the boat and nets require an outlay of more than $50,000. On an accrual basis, the annual cost for these items would approximate $14,000. Maintenance and overhaul of the equipment is estimated at 5 percent of cost per annum.

The number in the crew varies with the size of the freezer-ship. Small ships of 150 to 200-tons carrying capacity may carry as few as 6, while large ships of more than 500-tons carrying capacity sometimes carry 14 or 15 men. The wage scales for crew members are complicated, consisting of a combination of straight wages, overtime, percentage, run-money, and bonuses. Wage expenses and other data for a large tuna-type vessel engaged in the Alaska salmon-freezing trade are shown in table 70.

OTHER ASPECTS

Bristol Bay, Alaska, is 3,220[16] miles from San Diego, the home port of most tuna vessels. This distance is computed via Seattle to Nushagak Bay.

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[16] San Diego to Nushagak Bay direct, 2,820 nautical miles. Via Seattle and Ketchikan, 3,570 nautical miles.

The Alaska salmon-freezing industry provides the equivalent of one ip a year for tuna boats. Table 67 shows that the large vessels reraged about four tuna trips in 1950 and about three in 1951. Therefore, lmon-freezing is at best a partial substitute for tuna fishing.

EFFECTS ON SALMON INDUSTRY

Undoubtedly, if expanded on a large scale, freezing activities uld cause substantial changes in the present Alaska salmon industry d, indeed, in the economy of the Territory. At the present time arly all of Alaska's salmon are canned in shore canneries located various places in the Territory. These canneries are a source of bs and payrolls for the local inhabitants. In addition, numerous her businesses rely upon the Alaska salmon industry; for example, chine shops, transportation companies, stores, and suppliers, etc. the extent that the freezer-ships transfer from the Territory the w material which creates jobs and payrolls within the Territory, ey injure the Alaskan economy. Any benefit to tuna vessels from rticipation in the Alaska salmon fishery would appear to be at the pense of the existing Alaska salmon-canning industry and the rritory's economic welfare.

Possibility of Engaging in the Gulf of Mexico and Atlantic Coast Shrimp Industry

EXPERIENCE AND FUTURE POSSIBILITIES

The outlook for using any substantial part of the tuna fleet in e shrimp industry is poor. The high investment and operating costs nder their employment impractical. However, the shrimp industry is a period of rapid change with an increased use of fishing grounds greater distances from home ports. The advantages of greater cruis- g range and larger pay load characteristic of tuna vessels will become re important if this trend continues. In the event that future explora- ons in distant areas open highly productive shrimp grounds, several of e smaller tuna vessels might find profitable employment as shrimp awlers.

Freezer-ships in operation on the Campeche fishing grounds have met

Table 70.- DATA CONCERNING A CERTAIN TUNA-TYPE VESSEL WHILE IN THE ALASKA SALMON-FREEZING TRADE - 1952

Payroll

Position	Employees	Earnings
	number	dollars
Captain	1	5,751.26
Mate	1	2,036.53
Chief Engineer	1	5,626.32
First Assistant Engineer	1	4,593.37
Second Assistant Engineer	1	4,398.67
First Cook	1	2,611.53
Second Cook	1	1,611.53 1/
Deck hands	5	10,733.32
Total Vessel Payroll	12	37,362.53
Gill-net Fishermen	20	64,562.00 2/
		101,924.53
Employment taxes approximately 4 percent		4,076.98
Total Payroll	32	106,001.51 3/

Operational Data

Days on Trip	44
Gill-net boats carried	10
Estimated vessel carrying capacity, tons	600
Estimated load this trip, tons	370
Number of salmon this trip, fish	134,780
Number cases 48/1's packed from fish (approximately	10,250
Gross value canned salmon pack, at $26.00 per case	$266,500.

1/ Partial season

2/ Includes price for fish, run money, and shipboard wages.

3/ Includes some pre- and post-season wages. All such wages were not available and are not included.

th very limited success. In 1952, generally less than three were pres-
t on the grounds at any one time.

Many factors have contributed to the failure in the establishment of
trend toward the use of larger vessels as refrigerated freighters.
e preferred method of operation is to go to the Campeche grounds with
full load of ice and to return as soon as a load of shrimp has been
ught or until a shortage of ice makes the return imperative. Also, a
rge number of shrimp boats are owned or controlled by dealers and it is
their advantage to get all the production of these boats delivered
rectly to their plants. A third factor is that many of the small fleets
d independent shrimp boats fish seasonally in different areas and move
regularly, following reports of good fishing.

During 1952 the catch-rate on the Campeche grounds declined. If
ch a decrease in the catch per unit of effort continues, there may be
me changes in the methods of operation that could possibly involve
eater use of refrigerated transport vessels on these grounds.

COMPARISON OF FISHING VESSELS AND METHODS OF FISHING

The value of frozen yellowfin tuna delivered at the dock at the
esent time is $320 per ton. The larger vessels of the American tuna
eet catch tuna by live bait fishing or with purse seines. Both of
hese methods usually produce large tonnages of fish in a short time
hen fishing is successful. A single tuna vessel many times boats more
han ten tons in a single day and annual catches totaling one thousand
ns are not unusual. The value of iced or frozen shrimp delivered at
e dock varies with the size and species, but for purposes of comparison,
value of $1,000 per ton for headless shrimp may be used. A catch by
single shrimp vessel of as much as fifty tons of headless shrimp in one
ar is large. The daily catch with a shrimp trawl is seldom as much as
lf a ton of headless shrimp.

The design of long-range tuna vessels gives them large capacity for
ick handling of bulk fish. On the other hand, the limited catch of the
rimp trawlers makes design for extra large payloads unnecessary and
mpractical. Some increase in the catch of shrimp by use of vessels of
reater power and with nets of larger size has been obtained by shrimp
ishermen but in practice the cost of gear and vessels of larger size and
e expense and difficulty of maintaining and handling larger shrimp

fishing rigs has been greater than the results justified.

With the increase in the number of fishermen in the crew and by the use of larger vessels some increase in the catches of shrimp can be made by operation twenty-four hours a day. In most areas, however, shrimp fishing is productive only during the night or during daylight hours, depending on the species of shrimp being taken. Both day and night fishing are only rarely good in the same area at any season.

DIFFERENCES IN OPERATIONAL COSTS

The yearly replacement and maintenance cost of gear for a tuna boat would be substantially higher than shrimping gear maintenance and replacement. Operating and maintenance costs between tuna and shrimp vessels may be roughly estimated in the ratio of five to one.

The use of the larger, more modern, live bait tuna fishing vessels as catching boats for shrimp appears entirely impractical because the high operating and maintenance costs are out of line with potential earnings. Some of the smaller vessels of the tuna fleet might compete successfully in the shrimp fishery particularly on the more distant grounds. Generally these vessels would require some clearing of the deck structures, some new rigging, a winch and some provision for faster freezing of catches of shrimp where ice is not used.

Competition by boat owners for superior crews is strong in the southeastern states as it is elsewhere. Factors that tend to cut down the value of shares, such as high operating cost, a large crew, frequent loss of time through mechanical breakdown, if not offset by factors favorable to good crew earnings, would present serious difficulties to an owner.

Possibilities of Engaging in the Transport Trade

The diversion of tuna vessels to the transport trade is economically unsound. The largest tuna clippers having a capacity of 500 tons cost from $500,000 to $600,000 but on the open market a 10,000 ton freighter or a 5000 ton reefer ship can be purchased for $450,000 or $693,000 respectively. The operating costs per day for a 500 ton clipper exclusive of

es varies from $300 to $400 per day while on the same basis a 5000 ton
fer ship can be operated for $700 to $1200 per day depending on the type
area of operations. Assuming an average of $350 for a 500 ton clipper
$1000 for a 5000 ton reefer ship the operating cost exclusive of wages
3.5 : 1 per ton of capacity. The payroll per month, under United
tes maritime wage scales for a 15 man crew for ocean going service re-
red on tuna clippers, would be $5900 without overtime or war zone bonus-
But about $12,000 per month will cover similar base pay requirements
a 5000 ton reefer ship under the American flag. On a tonnage basis a
pper will pay about five times the wages per ton capacity when compared
a reefer ship.

Ocean freight rates vary in accordance with Shipping Conference tariff
es and ranges. Various lines operate in specific areas and a uniform
e applies by agreement at a conference to a given item. Another deter-
ng factor under the schedule is the standard practice of quoting rates
example, "From Panama or any Central American Port to any U.S. Pacific
rt, or any Atlantic or Gulf Coast Port," because any ship engaged in
ch runs usually makes all the major ports within an area. A sample
te from the Grace Line for tuna from Panama or any Central American
rt to San Diego or any West Coast Port is as follows:

antity tons	Rate short ton[17] dollars	Condition[18]
to 100	75.50	Non-contract
to 100	63.00	Contract
er 100	72.00	Non-contract
er 100	60,00	Contract

In addition to very unfavorable operating costs and low freight
tes, as contrasted to clipper-caught and transported tuna at about $300
r ton, the paper work involved in carrying cargo requires the services
experts. For each separate item of cargo, documentary charges involv-
g manifests, export declarations, ocean bills of lading, and insurance
ntracts are involved. Furthermore, when carrying cargo for hire the

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Various classes of dry stores very from 1/2 to 2/3 of these rates.
Contract is an agreement to ship all fish for one year.

vessels must comply with American Bureau of Shipping Requirements.

Fleet Operations

The tuna clipper could be easily converted to small-scall fleet operations involving a few catcher boats. There has already been some interest shown in this type of operation in the central Pacific grounds now under investigation by the Pacific Oceanic Fishery Investigations. The clippers, as motherships, probably could not carry catcher boats on deck to operate long-line gear. The smallest catcher vessels used successfully by the Japanese are about 50 tons. Attempts to transport such vessels even considerably lighter than 50 tons would present very serious questions of stability. Smaller catcher boats could be utilized if the stay at sea was not protracted, for instance in fishing out of one of the Line Islands. It is possible that such a fleet of boats could be used to fish for a succession of clippers arriving on the grounds.

There would be only a moderate amount of structural modification needed to convert to mothership operations. If the mothership also runs some long-line gear it would probably be necessary to eliminate the bait tank to provide deck space for the long-line hauler and storage of gear. Deck arrangements could be converted for highly efficient operation. The addition of a feathering propeller, a sailing clutch, or a reverse gear would be an important improvement over the direct reversible engine.

There are no other imperative changes. Space and quarters for the crew are sufficient. It is estimated that 9 men would be needed to operate a clipper as a mothership. If the vessel carried on additional fishing activities the crew would have to be increased to 12 or 18 men.'

SHOULD THE TUNA FLEET MOVE TO OTHER LOCATIONS TO OBTAIN MORE FAVORABLE OPERATING CONDITIONS?

New Areas Available to the Tuna Fleet for Fishing Operations or for Bases

Since the United States tuna clipper fleet is adapted to long-range fishing it is reasonable for the tuna industry to consider fishing in any tropical and subtropical waters of the Eastern Pacific and the Western Atlantic. Fishing conditions for tuna in the Tropical Eastern Pacific have appeared to be the best available and fishing effort has been concentrated in that area. Recently, the industry has given some attention to the possibilities for fishing operations in other areas. Two events have contributed to this development. The Pacific Oceanic Fishery Investigations has drawn attention to areas having an apparently productive potential of tuna in the equatorial waters of the Central Pacific, and exploratory fishing by the Branch of Commercial Fisheries in the Gulf of Mexico has indicated that previous estimates of the possibilities for fishing for tuna on the Atlantic side should be re-examined.

Segments of the tuna industry have plans, in various stages of development, for the operation of new tuna canning plants at Moss Point, Mississippi, and at Ponce and Guanica, Puerto Rico. These plants will operate on tuna taken in the Tropical Eastern Pacific, but their locations will enable them to take advantage of any fishing developments in the Western Atlantic Area. In the choice of locations, the fact that these Gulf and Caribbean ports are nearer the Tropical Eastern Pacific tuna fishing grounds than is southern California (see table 71) has been considered, as well as such factors as availability of labor, transportation, and local arrangements for some tax exemptions. These developments appear to be an expansion of the tuna industry rather than any large-scale movement of fleets or shore facilities.

WEST COAST TUNA CLIPPER

TABLE 71. - DISTANCES FROM PORTS ON THE PACIFIC, ATLANTIC, AND GULF COASTS OF THE UNITED STATES AND PUERTO RICO TO THE PANAMA CANAL AND THE WEST COAST OF COSTA RICA

	Balboa, Canal Zone	Puntarenas, Costa Rica
	Miles	Miles
Los Angeles	2,913	2,499
San Diego	2,843	2,429
San Juan, Puerto Rico	1,036	1,507
New Orleans	1,433	1,904
Charleston, South Carolina	1,607	2,078
New York	2,017	2,488

SOURCE: Distances Between United States Ports, United States Coast Pilo Series, United States Department of Commerce, Coast and Geodetic Survey, Washington, 1938.

GULF AND SOUTHEASTERN STATES

The supply of unskilled labor at ports in the Gulf and Southeastern States is adequate for considerable industrial expansion. There is some competition for skilled labor but it is unlikely that this would present any real difficulty to the operation of a tuna canning plant, the necessary complement to fleet operation. Experienced supervisory employees would have to be brought from the Pacific coast. The cost of labor is somewhat lower in the Southeastern and Gulf States than in the Pacific Coast States.

Vessel maintenance costs are comparatively low but facilities for m ium size vessels from fifty to five hundred tons are limited. There are eral deep-water ports on the Gulf coast that can accommodate even the la est clippers. Galveston, New Orleans, Mobile, and Pensacola have dry-do ing facilities. Repairs and maintenance not necessitating dry-docking a available at Tampa and Pascagoula. Supplies for vessels of this size ar not ordinarily carried in stock, and repair yards in general are not exp enced in handling the repair and maintenance of large fishing vessels. A the present time the cost of dry-docking, maintenance, repairs, and simi services for a medium size tuna clipper are lower in the Gulf area than other parts of the country, but, because of the small number of such vesse handled, a longer time is required to complete the work and it is questi ether the savings would represent a real operational advantage to a ssel owner.

The difference in shipping cost of the finished product (canned tuna) some markets from Atlantic ports compared with Pacific coast ports is bstantial. Carload railroad rates from Pascagoula, Mississippi, to w York, New York, for example, are $1.10 per 100 pounds for a 36,000 und car minimum compared with rates from Los Angeles, California to w York, New York of $2.52 per 100 pounds for a 40,000 pound car minimum, $1.86 for a 60,000 pound car minimum, and $1.81 for a 70,000 pound r minimum.

PUERTO RICO

There is a large resevoir of unskilled labor in Puerto Rico, and rmally there are several applicants for each job vacancy. Skilled bor is generally not available and must be trained or brought in from e United States. The labor costs are low, varying somewhat in different parts of the Island. In the San Juan area in 1952 unskilled labor rceived from fifty to fifty-five cents an hour, but in other parts of e Island unskilled labor could be hired for as little as thirty-five nts an hour. Opinion expressed by several employers interviewed in erto Rico in late 1952 was that the quality of unskilled labor was fair good but that the labor turnover rate was high. One employer cited, an example, that of approximately 300 production line employees laid f for a one-week holiday period, only 200 returned to work.

No federal income tax is collected on income earned in Puerto Rico United States mainland corporations which derive at least 80 per cent their income from sources within Puerto Rico and 50 per cent or more om the active conduct of a trade or business. No federal income tax collected on income earned in Puerto Rico by Puerto Rican corporations and partnerships or by individuals residing in Puerto Rico for a ole year. Furthermore, complete freedom from Insular income, property, d business taxes is available in Puerto Rico until June 30, 1959, and rtial freedom for an additional three years, on certain types of manufacturing. The processing of canned foods is a business considered igible for tax exemption. However, the Government of Puerto Rico has tablished a policy of denying such tax exemptions or other special nefits of its industrial program to any individual or firm proposing to ose a factory on the United States mainland in order to transfer it to erto Rico.

Laws relative to inportation of materials or articles of foreign origin, and laws relative to immigration are the same as on the United States mainland. There are no tariffs or quotas imposed on imports of manufactured or processed materials from the United States although excise taxes must be paid if applicable. No restrictions are placed on the sale in the United States of foods processed in Puerto Rico.

Roads are satisfactory for motor transportation of products from one port to another within the Island of Puerto Rico. Regular sailings are made to Atlantic and Gulf ports by vessels of the Bull Line, the Waterman Steamship Company, and Lykes Brothers Steamship Company.

No commodity rates are in effect from Puerto Rico to New York, New York, at present on canned tuna. The applicable rates at present are 97 cents per hundredweight for canned tuna from any Puerto Rican port with the addition of a 2½ cents wharfage impost per hundredweight for cargo loaded at San Juan, 3½ cents at Ponce, and 4 cents at Mayaguez. This compares favorably with carload railroad freight rates of $1.81 per hundredweight from Los Angeles, California to New York, New York or $1.10 from Pascagoula, Mississippi to New York, New York.

Puerto Rican fishermen are not experienced in offshore fisheries and it is questionable whether local fishermen would be obtainable for work on tuna vessels. Probably it would be necessary to bring most or all fishermen from the United States mainland for employment on vessels based in Puerto Rican ports.

Although United States fishermen could not be expected to be eager to move to Puerto Rico or any other area away from their established homes, the Puerto Rican housing, education and medical facilities are modern, and recreation is widely diversified. The foods and merchandise familiar to people on the United States mainland are readily available. The cost of living is slightly higher than in the United States.

VIRGIN ISLANDS

Insular programs to encourage new industries in the Virgin Islands are similar to the ones in effect in Puerto Rico.

THE PHILIPPINES, TRUST TERRITORIES AND EQUATORIAL PACIFIC

A report, Outlook for Development of a Tuna Industry in the Philippines (Warfel, 1950), indicates that the possibilities for production of large quantities of tuna in the vicinity of the Philippines are poor (under standard United States fishing methods). In this report it is pointed out that one of the important reasons why Philippine waters would offer little to the American tuna fleet is that "live bait fishing is handicapped by restricted bait supply".

The situation in the Trust Territory is similar but, in addition, obstacles of importance in the utilization of any stocks of tuna in the area are (1) absence of processing plants or difficulties of building and operating processing plants in the area, (2) unavailability of local fishermen trained in operations of large tuna vessels, and (3) probable unwillingness of United States tuna fishermen to move into the area for an extended period of time.

At the present time consideration is being given to requesting new bids for the lease of a fish cannery located at Tutuila, American Samoa. The cannery is complete with equipment and facilities, and is reported to be able to handle 21 tons of tuna per 8-hour day. Actual rated capacity of the equipment is 1,000 cases per day. The modern installation consists of 4 buildings, new devices for hand packing tuna, a rotary drier for processing the waste products into fish meal, and a cold storage area capable of freezing and/or storing approximately 240 tons of tuna. Dock facilities are adequate for fishing vessels, and electric power is available. Vessel maintenance facilities are limited. Steps are being taken to increase the limited water-storage capacity. Supply of local workers is reported to be adequate on the basis of trial runs. Transportation to and from the United States is via steamship lines which call at the Island at monthly intervals.

In connection with leasing the cannery, the Government of American Samoa is chiefly concerned in improving the local economy by providing employment and technical training for the local inhabitants. The cannery was erected following World War II by private enterprise,but was never successfully operated due mainly to a shortage of raw material(tuna). Distance of American Samoa (2,276 miles south of Hawaii) from established fishing grounds of the United States tuna fleet would necessitate exploitation of new fishing areas. Attempts by the previous cannery owners to take tuna near Samoa by established American methods were unsuccessful.

It is likely, therefore, that different gear, such as long lines, would need to be employed to take advantage of the rich tuna grounds recently found in Central Pacific equatorial waters by the Pacific Oceanic Fishery Investigations. Besides the normal problems involved in establishing an industry in such a remote place there is also the problem of proving conclusively that tuna can be taken in the area in sufficient quantities to support profitable canning activities. Should the operation prove successful, only a limited number of fishing vessels would be required.

It is reported that fresh or frozen tuna may enter American Samoa free of duty. Canned tuna is dutiable at 15 per cent ad valoreum. Exports of products from American Samoa are subject to an export duty of 2 per cent of appraised value. Further information concerning customs problems with respect to American Samoa is given in the following letter from the U. S. Bureau of Customs to the Special Assistant for Fisheries and Wildlife to the Under Secretary of State:

(COPY)

TREASURY DEPARTMENT
BUREAU OF CUSTOMS
WASHINGTON 25, D. C.

Feb. 25, 1953

Mr. William C. Herrington
Special Assistant to the Under Secretary of State
Department of State
Washington 25, D. C.

Sir:

Reference is made to your letter of December 8, 1952 (U/FW) stating that negotiations are under way between an American business concern and the authorities of American Samoa for the lease to and operation by the former of a tuna cannery situated in that territory. As the canned product would be marketed in the continental United States, you request information regarding several matters pertaining to such shipments to the United States.

You ask first for information regarding the dutiable status of canned tuna shipped to the continental United States, whether in oil or in brine, which emanated from American Samoa as a product of that territory. Such canned tuna brought into the United tates from Samoa is not subject to customs duties because it is ot imported from a foreign country.

You then ask: "If United States legislation were enacted stablishing an quota and/or duty with reference to fresh and rozen tuna imports, would it apply to fresh and frozen tuna anded in American Samoa by a foreign country (provided of ourse that American Samoa were not especially dealt with in uch legislation)?"

If the legislation provided for a quota on United States imorts, without more, it would not apply to imports into American amoa because American Samoa is not a part of the customs territory f the United States.

Whether or not a quota on "imports" of tuna would apply to hipments from Samoa of tuna landed there by a foreign country ould depend on the answer to the question whether shipments from amoa are "importations" for tariff purposes. Since American Samoa s a possession of the United States, it is not a foreign country nd shipments therefrom would not be importations into the United tates, if the merchandise had actually been imported into Samoa s distinguished from passing through Samoa in transit.

You also ask whether Public Law 751, 81st Congress, prohibits he landing in American Samoa of fresh and frozen tuna fish by a apanese flag mother ship or fishing vessel proceeding there as uch or as a cargo vessel direct from fishing grounds on the high eas. You inquire in addition whether such law prohibits the anding there by a United States flag vessel of fish cargo acquired y direct transfer on the high seas from a Japanese flag mother ship.

Except as other wise permitted by treaty or convention, section 311 of the Revised Statutes (46 U.S.C. 251), as amended by the ct of September 2, 1950 (64 Stat. 577), prohibits a foreign-flag essel, whether documented as a cargo vessel or otherwise, from anding in a port of the United States its catch of fish taken on oard on the high seas or fish products processed therefrom, or any ish or fish products taken on board such vessel on the high seas rom a vessel engaged in fishing operations or in the processing of ish or fish products.

The Bureau is of the opinion that the statute does not apply to the landing of fish or fish products in any port of American Samoa. Accordingly, a Japanese flag mother ship or fishing vessel, whether proceeding as such or as a cargo vessel direct from fishing grounds on the high seas, is not prohibited thereby from landing in American Samoa fresh or frozen tuna fish taken on the high seas, nor does such law prohibit a United States flag vessel from landing at American Samoa such a fish cargo aquired on the high seas by direct transfer from a Japanese flag mother ship.

Very truly yours,

(Sgd.) FRANK DOW

Commissioner of Customs

The discovery of rich, new, tuna grounds in Central Pacific equatorial waters casts yet another hue on any consideration of buttressing the economic position of our domestic tuna fishery. In discussing this subject thus far, empahsis has been made principally on the possibilities of improving conditions in present areas of operation. The field of new areas of operation is also important in the consideration of the economic welfare of the tuna industry because of its significance in the event of any possible deterioration in the productive capacity of the present fisheries.

Although there have been some changes through the years in areas fished by the domestic fleet, the great bulk of the domestic catch has been taken in the general area of the Eastern Pacific Ocean. There are other areas which also offer commercial possibilites of tuna fishing on a large scale by domestic fishermen which are in a relatively undeveloped stage. These areas are the Western Atlantic or Atlantic Coast Area, Gulf of Mexico and Caribbean Area, and the Central Pacific Area. The likelihood of the development of fisheries for tuna in those areas is considered next.

WHERE TUNA ARE AVAILABLE AND ARE NOT FISHED BY DOMESTIC COMMERCIAL FISHERMEN, IS IT LIKELY THAT A COMMERCIAL FISHERY WILL BE DEVELOPED BY UNITED STATES INDUSTRY?

Atlantic Coast

BACKGROUND OF ATLANTIC COAST TUNA FISHING

Reports of bluefin in Atlantic coastal waters and particularly ff New England date back many years. Fishermen on Cape Cod were atching them in traps as early as the 1880's. The large bluefin, eferred to in the past as "horse mackerel", have also been sought by port fishermen for the past few decades. Bluefin are present in New ngland waters from June to October and are taken by various forms of ishing gear from waters south of Cape Cod and north as far as Nova cotia. Over the years, landings from Cape Cod Bay trap and pound ets have accounted for the bulk of New England tuna production, with atches by small vessels using harpoons, and sportsmen accounting for small part. The fishing has been on a small scale compared to the acific coast tuna industry.

Efforts to increase the exploitation of New England bluefin have een made several times, with limited success. From 1938 to 1941 a mall number of Gloucester mackerel seiners and one Pacific coast seine oat tried purse seining for bluefin and achieved fair success. Indiidual landings up to 100,000 pounds were made. The venture was abanloned after the 1941 season, principally because of an unsteady market nd low prices offered by the fish buyers of the region.

During 1950, interest in the possibility of establishing a tuna rocessing industry utilizing Maine sardine-canning plants during eriods of normal off-season shutdowns led to an appropriation of funds y the Federal Government for the investigation of the commercial poentialities of bluefin in the Gulf of Maine by the Fish and Wildlife ervice. The first year's exploratory fishing program, utilizing a urse seiner, was carried out from June to October, 1951 (Murray,1952). bjectives were: (1) to determine the location, extent, and range of luefin tuna concentrations in New England coastal waters during the ummer and fall seasons; (2) to determine whether the bluefin tuna are onsistently available in sufficient quantities to warrant expanded commercial fishing operations; and (3) to test various fishing methods and equipment and to determine the most efficient methods for capturing tuna in commercial quantities.

The 1951 program was successful, resulting in a total catch of 180,000 pounds of bluefin and further demonstrating that tuna in commercial quantities inhabit these waters during the summer months. In 1952 the exploration was continued, employing long lines and gill nets as the principal fishing equipment. Results obtained were inconclusive from a commercial fishing standpoint. The Japanese-style long lines produced excellent individual catches of tuna over a wide area in the Gulf of Maine, but results were inconsistent and the total catch was not large. Many more sharks were caught than tuna. Preliminary reports indicate that the 1952 season was one of the poorest on record from a production standpoint, only 218,000 pounds of tuna being taken in the Cape Cod traps as compared to 800,000 pounds in 1951. This indicates the fluctuating nature of the tuna run in the region, which will be a factor in future development.

From existing evidence, it appears that bluefin are closely associated with the Gulf Stream. This current flows approximately 300 miles off the New England coast, southeast of the important fishing grounds from Georges Bank to the Grand Banks. Lying outside of the regular fishing grounds, these waters are seldom visited by the commercial fishing fleet, and it is quite possible that bluefin stocks are in abundance in this offshore area for a part of the year, at least, and are available for exploitation.

Live bait tuna fishing or "poling", practiced by Pacific coast tuna clippers, has never been tried on the Atlantic coast. Good catches of medium-sized bluefin have been made in recent years by trawl fishermen in the Gulf of Maine using hand lines and fresh herring and mackerel for bait. Catches were incidental to regular fishing operations. In 1951 over 140,000 pounds of bluefin were caught on hand lines by otter-trawl fishermen and marketed in Gloucester and Boston. Chum made from ground herring has been used successfully in attracting and holding bluefin schools alongside fishing craft.

For a number of years, little tuna have been taken in fair amounts in ocean pound nets in late summer and early fall off the coasts of New York and New Jersey. No organized commercial fishery for the species has ever been maintained, and it has usually been taken along with other species of fish. Landings have also been made at irregular intervals all along the Atlantic coast south of Cape Cod by trolling oats, beach seines and occasional purse seiners.

QUANTITIES AND SPECIES AVAILABLE

Three species of tuna and tunalike fishes are known to be present in substantial quantities in Atlantic coastal waters. These are: 1) bluefin; (2) little tuna; and (3) common bonito. Atlantic coast ommercial catches for 1950 were:

Bluefin	1,267,200 pounds
Little tuna	295,900 "
Bonito	123,500 "

Of the three species, the bluefin is by far the most important rom the standpoint of past production and desirability for canning urposes, producing a light meat of average texture and good quality. ny industrial development of the tuna fishery in New England would e dependent, at least in a large part, upon this species.

Annual landings of bluefin on the Atlantic coast have in some ears exceeded 2 million pounds. This production has been primarily rom traps and inshore fishing vessels. Therefore, the off-shore otential of the species is unknown, and little data are available n such things as life history and total extent of the population. hey reach their greatest abundance on their yearly migration into he Gulf of Maine in the summer months. It has never been definitey determined where they come from or where they go after leaving ew England waters each fall. New evidence has recently been unovered indicating a spawning ground off southern Florida, but miration routes and range limits in the Atlantic are unknown. Until ore information is available, it is impossible to even guess at the bundance of bluefin which may be available. The consistency of appearance (with some fluctuations from year to year, which are not bnormal in tuna fisheries) in the Gulf of Maine each summer and the act that large schools yielding catches of over 100,000 pounds to urse seiners have been found relatively close to shore indicates hat the resource may be far greater than past production figures eveal. More offshore exploration and increased employment of acive gear such as purse seines and hook and line with live bait may esult in an expansion similar(but perhaps on a reduced scale) to hat of the Pacific coast tuna fishery in the past 30 years.

Little tuna are found in Atlantic coastal waters from Cape Cod to Florida. Evidence points toward a seasonal northward migration from Florida to Massachusetts, starting in April and returning south in October (Carlson, 1951). Catches by ocean pound nets situated along the New Jersey and New York coasts account for the majority of the little tuna landings in the Middle Atlantic region. Little real information is available concerning the abundance and life history of the species. They are taken occasionally, and sometimes in good quantities, by trolling gear from Florida to Cape Cod, and are often considered a nuisance by sportsmen who are after larger game fish. In 1951, an exploratory survey by the Fish and Wildlife Service in cooperation with a South Carolina fish processing firm, supported previous conclusions that little tuna occur over a wide range and can be taken with commercial trolling gear, but unfavorable weather hampered purse seining operations to some extent. All fishing for this species has been near shore, and much more exploration must be undertaken before the potentialities of the resource can be adequately evaluated. However, it is apparent that even the known stocks are not being fully exploited at the present time.

Little tuna was canned in small quantities in Maryland and Virginia in 1946 and processing continued during the next few years. Results were encouraging and offered considerable hope for further development on a considerable scale (Chilton,1949). Landings of little tuna in the New York wholesale fish market during the period from 1940 to 1952 averaged 220,000 pounds annually.

Bonito appear to be closely related to the little tuna in habits and occurrence. Few are taken north of Cape Cod,but they are caught in small quantities all along the Atlantic coast to Florida. They are caught with trap nets and beach seines and on hook and line, frequently by sportsmen. Most of the production in recent years has been from the South Atlantic States and Chesapeake Bay. No organized commercial fishery exists for the species and like the bluefin and little tuna, very little is known concerning its total abundance.

AVAILABILITY OF LOCAL FLEET AND FISHERMEN

With few exceptions, fishing craft operating in the Atlantic are unsuited for large-scale tuna seining operations. Tuna purse seines are of tremendous size with lengths ranging from 300 to 400 fathoms, depths from 20 to 40 fathoms and generally weighing from 7 to 10 tons.

New England boats engaged in mackerel purse seining operate light seines which are set and hauled from accessory or seine boats. Menhaden purse seiners operating from Middle Atlantic and South Atlantic ports, while considerably larger than the mackerel seiners, also use accessory boats, and generally these craft are not more suitable for conversion to Pacific-style tuna seining than the smaller New England type mackerel seiner.

The Pacific coast tuna seiner is the proven and effective type for this fishery. The use of present style menhaden and mackerel purse seiners in a bluefin fishery might be moderately successful with a few minor changes. Conversion of these craft to stern-set Pacific coast seiners is probably impracticable. Estimates from shipbuilders of the cost for installation of turntables, re-location of pilot houses and changing the deck layout of a typical mackerel seiner are extremely high and in most cases approximate 40 percent of the ship's value. New England otter trawlers, typically with house aft, are likewise unsuited for ready conversion to seining. It would probably be more practicable and economical to operate west coast tuna seiners than to attempt conversion of east coast fishing boats.

Most of the small and medium size fishing boats operating in the Atlamtic fisheries can be readily adapted to long line fishing operations. Installation of necessary equipment can be easily accomplished in the majority of cases without necessitating major changes in deck arrangements or machinery. Conversion costs would be relatively low with procurement costs for gear, line hauler, and side roller representing the major outlay. Generally, small otter trawlers, line trawlers, gill netters and similar craft ranging from 35 to 50 feet in length and in the 5 to 40 net ton class would be suited for inshore fishing within an operational distance of approximately 50 miles from land. The offshore fishery would require larger boats such as medium otter trawlers, scallop dredgers and mackerel seiners in the 60-100 foot range and from 45 to 95 net tons.

Procurement and installation costs for line hauler, side roller, minor accessory gear, and the long line required for equipping these types of boats for long lining are approximately as follows:

Line hauler and side roller......................	$800.00
Power and transmission unit for line hauler......	400.00
Long line (per basket)...........................	35.00

Tuna long-line haulers are not manufactured in this country; the above costs include transportation from Japan. For those boats which can furnish power for the line hauler from their own propulsion machinery, a separate power unit would not be required. Supplies for rigging long lines are easily obtainable from maritime supply houses. It is estimated that a maximum of 100 baskets of gear would be sufficient for full-time operation.

Live bait fishing requires a specialized type of craft, and a survey of the fishing boats operating along the Atlantic coast reveals that few boats are considered suitable for conversion purposes. Conversion of trawlers and menhaden purse seiners to a style akin to the accepted and efficient California tuna clipper would be costly and would involve a considerable risk, at least until a live bait fishery has been proven practical in these waters. Development of an Atlantic live bait tuna fishery would seem to be dependent upon the employment of conventional type Pacific coast tuna clippers.

The development of a successful tuna fishery in the Atlantic would require employment of skilled fishermen and trained personnel. Unquestionably this manpower can be found in the fishing industry of the Atlantic coast. Captains and key crew members experienced in tuna fishing would be needed. The menhaden, mackerel and herring purse seine fisheries have been carried on from Maine to Florida since the early 1900's and men from these fisheries would be available for any large-scale tuna purse seining development. Tuna long line fishing differs only slightly from line trawling as practiced in the New England ground fishery and no difficulty would be experienced in obtaining skilled fishermen for this work. Very few fishermen experienced in live bait tuna fishing can be found along the east coast. Some men now engaged in otter trawling and seining have fished on tuna clippers out of California ports but the number is small and not to be reckoned with in terms of crews for a sizable live bait fishery. Training of experienced fishermen in live bait fishing technique would not be difficult and indications are that at least 50 percent of a vessel's crew could be recruited from the east coast at the present time.

AVAILABILITY OF BAIT

While no organized live bait tuna fishery has ever been carried on off the Atlantic coast, adequate supplies of herring and other clupeoid fishes are available to supply the demands of an extensive fishery.

ound and trap nets, stop nets and purse seines in New England and the iddle Atlantic States produce huge quantities of herring during the luefin season. Mackerel, squid and menhaden, considered to be excelent tuna bait for long lines, are also in abundant supply and easily btainable.

Facilities for transferring live herring from fixed fishing staions to live bait boat tanks are found in ports from eastern Maine to ape Cod. In 1952 a California-type tuna clipper loaded 100 bushels f live herring from a Maine weir and kept the majority of the fish live in bait tanks for several days before leaving the area. Subtantial quantities of squid are also caught by New England pound nets uring the summer months. An ample supply of either fresh or frozen ait is available for long line fishing. New England ports where suplies of live and frozen bait may be obtained are as follows:

Maine..........Eastport, Rockland, Boothbay Harbor, Harpswell, Portland.

Massachusetts..Gloucester, Boston, New Bedford, Provincetown.

Rhode Island...Newport, Point Judith.

Connecticut....Stonington.

MARKETS AND CANNERIES AVAILABLE

Five tuna canning plants which have operated recently have a comined capacity for processing approximately 100 tons of raw tuna daily, nd their operations represent the best outlet for marketing the prouction from an expanded Atlantic tuna fishery. Location of the caneries is as follows: Eastport, Maine; Gloucester, Massachusetts; anticoke, Maryland; Tighlman, Maryland, and Beaufort, South Carolina.

Information received from officials of two New England tuna caneries is that these plants are capable of processing a combined total f 50 tons of raw tuna daily. The South Carolina cannery has a daily rocessing capacity of 10 tons of raw tuna. A realistic estimate of he annual processing capacity of these three plants in terms of raw una would be 13,000 tons. Data concerning annual processing capacty have not been received from the Maryland canneries. Testimony iven by the treasurer of one Maryland firm, before the Senate Finance

Committee in February, 1952, stated that Japanese and Peruvian tuna imports, landed usually at New York or Baltimore, constituted the main supply source for this company.

PORTS AND COLD STORAGE FACILITIES

Determination of satisfactory ports for marketing tuna catches is dependent upon many factors, some of which have been previously indicated. Besides, adequate docking space, unloading facilities, proximity to fishing grounds, availability of markets and cold storage space, provision for maintenance and servicing facilities should be available. While the majority of the major North Atlantic ports possess these facilities in varying degrees, the following ports from Maine to South Carolina may be rated as follows:

Gloucester, Massachusetts..........Excellent deep water port, possessing ample docking and discharging space. Location of tuna cannery with facilities for packing 75 tons of raw tuna weekly; company has purchased individual tuna trips totalling 290 tons. Good transshipping point for forwarding tuna to eastern tuna canneries. Servicing and maintenance facilities for fuel oil, ice, bait, hull and machinery repairs considered adequate. Local marine railways can drydock ships up to 200 gross tons and larger ships can be drydocked in Boston shipyards. Limited market for fresh tuna with approximately five fish dealers located in the port. Cold storage space limited at the present time, but construction of proposed new freezer plants will provide adequate storage space.

Boston, Massachusetts ....Excellent deep water port, with docking and discharging facilities available at Boston Fish Market Corporation pier. Facilities for freezing and storing a minimum of 4200 tons of tuna available in the Boston Metropolitan Area. Good shipping point for delivery of tuna to Eastern canneries. Port has adequate servicing and maintenance facilities for handling large tuna clippers. Limited market for fresh tuna with approximately ten dealers interested in this phase of the industry,

New Bedford, Massachusetts ....Largest fishing center in southern New England, advantageously situated in relation to fishing grounds of the southwestern part of Georges Bank,Nantucket Shoals and eastern Long Island waters. Port has six marine railways, capable of handling ships ranging from 10 to 500 gross tons. Excellent machine shops located here with provisions for effecting major repairs. Local freezers of the blast tunnel type can freeze 50 tons of fish daily and have a storage capacity of 2500 tons with space for storing 500 tons of round tuna. Ample docking space for discharging fish at private and state-owned piers.

New York City ...... Best location of all North Atlantic ports for discharging tuna trips destined for tuna canneries in the Middle Atlantic and South Atlantic Regions. Docking and unloading facilities available at Fulton Fish Market piers. Fleet maintenance and ship supply services available for unlimited tonnage craft in the area. Largest fresh tuna market on east coast. Estimated capacity of freezer and storage space available for tuna holdings is 1500 tons. Closer to fishing areas south and west of Cape Cod but considerably farther from fishing grounds north and east of Cape Cod than most of the New England fishing centers.

Portland, Maine ....Deep water port with fair facilities for handling limited production. Docking space available at four private docks with additional space available at State of Maine pier in the event that heavy production is indicated. Excellent servicing and maintenance facilities for medium size fishing boats. Marine railways can handle ships up to 200 gross tons. Port is within reasonable distance of tuna cannery at Eastport, Maine.

Beaufort, South Carolina.....Site of tuna processing plant with one dock suitable for unloading large tuna clippers. Freezer space for 350 tons and storage space available for 250 tons of tuna in the immediate area. Annual capacity of tuna processing plant estimated at 2000 tons.

Cape May, New Jersey......Good harbor with limited docking space. Location excellent in respect to fishing operations southwest of New York to Carolina coast. Supply and maintenance service poor. Recommended for emergency use by medium and small size craft for transshipment of tuna fares. No record of any available cold storage facilities.

Rockland, Maine......Located within reasonable transport distance of Eastport, Maine, and suitable for unloading tuna fares destined for immediate shipment to canneries or freezers. No freezer or storage facilities. Arrangements for use of pier for unloading would depend on cooperation of local fish company. Supply and maintenance facilities fair to poor. Recommended for small scale operations provided clearance for use of dock space is obtained.

Provincetown, Massachusetts....Limited facilities suitable for small and medium size boats. Insufficient water at low tide at docks for boats drawing over 9 feet although bottom is composed of sand and mud and grounding would not cause damage to boat. Freezer and storage facilities for 1225 tons of tuna are available in the immediate area. Limited ships services, supplies and maintenance facilities indicate emergency use of this port by small craft only. Definitely not recommended for purse seiners and clippers.

Information received from cold storage plant operators located in Maine and Massachusetts is that adequate freezing facilities and cold storage space for handling a minimum of 7,125 tons of raw tuna yearly are known to be available in these states. Replies were received from nine companies, all located in coastal cities. In Maine, two plants reported a combined storage space for 1100 tons; four plants in the metropolitan Boston area reported storage space for 4200 tons; four plants in the Cape Cod area have storage space for 1225 tons, and New Bedford plants have storage room for 500 tons. Plans are under way for the construction of two new plants in Gloucester, and any tuna industry expansion in New England will not be retarded by lack of freezer and storage facilities. At Beaufort, South Carolina, a fish processing firm has cold storage space for 250 tons of tuna.

Gulf of Mexico and Caribbean Area

TRENDS TOWARD DEVELOPMENT OF A TUNA FISHERY IN THE GULF AND CARIBBEAN AREA

Any extensive development of a fishery for tuna in the Gulf of Mexico and Caribbean region on a year-round basis will necessarily involve fishing in a relatively wide range, north and south, because throughout the area where tuna are reported in relative abundance their occurrence is seasonal. The geographical ranges, seasonal distributions, and habits of the various tuna fishes in the western North Atlantic are not well known but the weight of available evidence indicates, for example, that mature bluefin move from the Caribbean along he Atlantic coast on their northward migration in late spring and sumer, and that lesser movements of other species occur, northward in ummer and southward in winter.

Two independent lines of development in a tuna fishery in Gulf and aribbean waters are possible. One of these involves fishing by relaively small, short-range vessels inshore or close to a base and often n a seasonal or part-time basis. Fisheries of this character are now n various stages of development.

A small but successful live bait fishery has been developing in uba since 1942 (Rawlings,1953). The production of this fishery in 1952 mounted to about 3,000,000 pounds of raw eviscerated tuna, mostly takn within Cuban territorial waters. The canned product, processed and arketed within Cuba, is estimated to satisfy about 85 percent of the resent Cuban market demand and replaces a canned tuna product formerly mported from Spain.

The French Colonial Administration expects delivery of a 60-ton urse seiner at Martinique in 1953 to be used chiefly in fishing for ellowfin and blackfin occurring seasonally over banks near Martinique.

As a part-time activity, a fish processing firm at Beaufort, South arolina processes relatively small quantities of the little tuna taken rom inshore waters of the Atlantic and Gulf States. The stocks of litle tuna on which this production is based occur within the limits of he continental shelf along the Middle and South Atlantic and Gulf tates and are believed to be adequate for considerable expansion of ishing for the species (Carlson,1951).

The existence of a successful live bait fishery for tuna in Cuba s evidence that Caribbean tuna stocks can be exploited. That local, easonal fishing for tuna off the Atlantic and Gulf States, Puerto ico, and the Virgin Islands, as well as in Caribbean countries will be radually and slowly expanded is a reasonable expectation. However,such n expansion should be expected only where canning facilities and favor ble market conditions exist, and production should be expected to remain mall relative to the landings of American tuna vessels of the long-ange fishery.

The second line of development of tuna fishing in the western North tlantic involves the use of long-range refrigerated fishing vessels and s potentially a source for much greater production. No operations by ong-range commercial fishing craft have been attempted up to the present time. In 1951 and 1952 the exploratory fishing vessel Oregon of the Fish and Wildlife Service reported extensive schools of tunas in the central Gulf of Mexico. Since 1951 interest in the tuna resources of the offshore areas of the Gulf and Caribbean has greatly increased.

QUANTITIES AND SPECIES AVAILABLE IN THE GULF AND CARIBBEAN

Tunas have been reported in the region many times, particularly in the Caribbean, but observations of large numbers have been relatively few. Commercial fishermen on the Atlantic coast are familiar with the bluefin and fishermen of both the Atlantic and Gulf coasts are familiar with the little tuna. Other tunas ordinarily occur in waters outside the areas of customary fishing activity. Commercial fishermen of the Atlantic and Gulf States generally do not distinguish little tuna from other species of small tunas when they observe them in the water. It has been noted (Whiteleather and Brown, 1945), that even in fish markets of Trinidad little distinction is made between the relatively dark meat little tuna and the light meat blackfin. Because of the relatively lower quality of the little tuna and because only limited local markets have existed, the species has been of comparatively little interest to commercial fishermen. The prevailing opinion that tuna stocks in the western North Atlantic were insufficient to support a large fishing operation has been altered somewhat since 1951 when large numbers of blackfin were reported by the exploratory fishing vessel Oregon in the central Gulf of Mexico. Subsequent exploratory work in the Gulf of Mexico and a re-examination of reports of tuna in the Caribbean leads to the conclusion that large stocks of tuna exist in that area.

A point of special interest to the American fishery is that what up to now appears to be the commonest Gulf and Caribbean pelagic tuna, the blackfin, is taken by the Cuban fishery with live bait (Rawlings, 1953). Furthermore, two other tunas reported offshore in the Gulf by the Oregon, the yellowfin and the (white) skipjack, are either closely allied to, or identical to tunas making up the bulk of the catch of the American tuna fishery in the Pacific, where the majority are taken with live bait.

The presence of large stocks of tuna does not necessarily insure that large catches are available to the fishermen. There are some obvious difficulties to fishing in the Gulf and Caribbean area. The tunas do not show at the surface often as compared to tunas in the American Pacific fishery. Weather conditions for tuna fishing generally are not so favorable as in the Tropical Eastern Pacific. Most important, however, is that comparatively little is known of the movements and habits of the pelagic tunas of the Gulf and Caribbean.

The tunas known from the Gulf and Caribbean area are listed in table 72. The relative abundance of the species cannot be determined from the data available, but the three species of most interest to the live bait fishery, the blackfin, the yellowfin, and the (white) skipjack, are found at some seasons over the entire Gulf and Caribbean area in blue waters off the continental shelf.

TABLE 72. - TUNA AND TUNALIKE FISHES OF THE GULF OF MEXICO AND CARIBBEAN REGION

Common Name	Scientific Name 1/	Size	Reports of presence in			Quality 2/	Methods of fishing where taken elsewhere
			Gulf of Mexico	Western Caribbean	Eastern Caribbean		
Blackfin (Albacore in Cuba)	*Parathunnus atlanticus*	Inshore South Cuba-Av.3 Lbs. may reach 60 pounds	Offshore in summer and fall	Off south shore of Cuba - year around	Spring and year around	Light meat	Live bait in Cuba
Yellowfin (Allison's tuna)	*Neothunnus argentivittatus*	Commonly up to 150 pounds	Offshore North and Central Gulf in summer	Spring and summer	Barbadoes - Martinique-April through September	Light meat	Live bait, purse seines, long lines in Japanese fishery
White skipjack (Oceanic bonito)	*Katsuwonus pelamis*	Commonly up to 20 pounds	North and Central Gulf in summer, Offshore Straits of Florida, in summer	Small examples 25% of Cuban fishery taken year around	Larger fish not uncommon, associated with yellowfin	Light meat same as yellowfin	Live bait, purse seines
Bluefin (Tunny)	*Thunnus thynnus*	Commonly up to 500 pounds - Large ones up to 1,000 pounds	Not yet reported in Gulf	Present	No information	Light meat	Harpoons, traps, purse seines in Pacific and experimental fishing in New England
Little tuna (Bonito on Gulf Coast)	*Euthynnus alletteratus*	Commonly up to 20 pounds	Common inshore throughout year, Rare offshore.	Common inshore, less common offshore	Throughout inshore and "green" waters	Can be packed as light meat	Trolling, purse seines, hand lines with dead bait and chum, traps and beach seines
Bonito	*Sarda sarda*	Up to 10 pounds	Only reports, Straits of Florida and Campeche Oct. and Nov.	No information	No information	Sold fresh on upper Atlantic Coast	Trolling, beach seines, pound nets and traps

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1/ Names from Rosa, 1950.

2/ Little technological information is available on the comparative qualities of the Atlantic tunas after canning. Estimates based on appearance of the fresh meat and the experience of the Cuban fishery place the black-fin as the highest quality.

AVAILABILITY OF LOCAL FLEET AND FISHERMEN

Seasonal fishing for little tuna inshore by fishing boats normally engaged in the Gulf of Mexico fishery for king mackerel, Spanish mackerel or for shrimp is a practical possibility. Many fishermen along the coasts of Florida and adjacent States have sufficient experience and either own or have satisfactory boats and gear available for inshore trolling for little tuna. No dependable market to the fishermen for these fish has ever existed, and the development of much activity in the fishery would require solution of special problems in handling the catches ashore because the landings would be seasonal and not large at any one point.

During June 1952 the exploratory fishing vessel Oregon took 1,500 to 4,000 pounds of little tuna on several successive days in and near the Dry Tortugas shrimp fishing grounds. The fish, weighing an average of 14 pounds, were taken by hand lines using dead bait and scrap fish for chum. The fishermen present on the grounds at that time were interested in the possibility of catching little tuna as a part-time activity during the summer season of relatively low shrimp production because the bait can be taken incidental to the shrimp trawling at no extra cost and because the daily period of fishing activity for little tuna occurs in a one or two hour period at dawn immediately after shrimp trawling stops. However, there was no appreciable production in 1952 because of the absence of a dependable market at the docks where shrimp were landed.

Larger catches and larger landings of little tuna at one port could presumably be made by fishing with purse seines. It remains to be demonstrated, however, that little tuna can be taken regularly and in sufficient number by purse seines to justify the relatively high investment in gear and vessels. If markets warranted the use of purse seines for little tuna, some of the vessels of the menhaden fleet would be available. Some of the smaller ones having load capacity too small to profitably compete in handling the comparatively low-value menhaden might operate more successfully on a higher value product such as tuna.

Pascagoula, Mississippi, is the home port for two live-bait una clippers fishing in 1952 on the Pacific tuna grounds and elivering catches to the Atlantic ports of Beaufort, South arolina, and Gloucester, Massachusetts. If exploratory fishing emonstrates that tuna can be taken in the Gulf and Caribbean in ufficient quantity with live bait, it is to be expected that these essels would divert all or part of their fishing from the Pacific o this area.

Other than these two, there are no Atlantic-based fishing essels of satisfactory design to enter the long-range live-bait una fishery without expensive conversion. Crews could be ecruited from the local reservoir of fishermen to partially man ny additional tuna boats brought into the region. But experienced una fishermen would have to be obtained from the Pacific coast o train the local men, at least for the first few years of peration.

AVAILABILITY OF BAIT

A preliminary survey of the sources for live tuna bait in he Gulf and Caribbean is promising. The Cuban fishery uses the ajua or round herring (*Jenkinsia lamprotaenia*), and the cabezona r hard-head (*Atherinomorus stipes*), successfully. Both species re widely distributed and are said to be common. The *Oregon* ook large quantities of the majua and the Spanish sardine (*Sardinella anchovia*), in December 1952 by use of lights and lift ets off the Yucatan Peninsula. The latter species appeared to be ery hardy under tank conditions and displayed a behavior pattern hat seemed desirable for tuna bait. It has not yet been used in ishing trials. In August 1952, large quantities of young jacks (*Carangidae*), of two or more undertermined species were observed in he north central Gulf by the *Oregon*. These also are believed to ffer a promising possibility as tuna bait. Additional information s needed on seasons and areas of abundant bait supply as well as n the behavior of bait species of the Gulf and Caribbean.

MARKETS AND CANNERIES AVAILABLE

There is little or no market demand for fresh tuna in the est Indies or Gulf Coast Area at present, and local fishing evelopments are intimately connected with the availability or evelopment of canning facilities.

The tuna canning plant at Beaufort, South Carolina, which has been mentioned, is a possible outlet for tuna production in this area. This operation is being carried on now in part with landings of Pacific tuna boats of the United States fleet and some little tuna from the Gulf and Atlantic States. A building for a tuna canning plant has been erected at Moss Point, Mississippi. Present plans are for this 20-ton-a-day plant to begin operation early in 1954. Two canneries, one of 30-ton daily capacity and another of 150-ton daily capacity, are planned in Puerto Rico. At present it is not possible to estimate the importance of these projects to the development of a Gulf of Mexico tuna fishery. These canneries are expected to operate on fish obtained from the Pacific but would also serve as a market for production of the less distant Atlantic fishing grounds if these are developed.

Gulf shrimp canneries may be converted to part- or full-time operation on tuna without great difficulty. But the capacities after conversion would not be great (generally less than 30 tons daily) and, in comparison with the most modern tuna canneries, efficiency would be low.

PORTS AND COLD STORAGE FACILITIES

There are numerous ports on the Gulf coast possessing adequate facilities for small craft which might enter a localized tuna fishery. Those now serving the shrimp fleet can accommodate the needs of these smaller vessels. Costs of vessel maintenance are comparatively low in the region. Facilities for handling large tuna seiners or clippers are limited although several deep-water ports could be used as bases for even the largest bait boats. Dry-docking facilities are available at New Orleans, Mobile, Pensacola, and Galveston for the larger craft. It could be expected that, if the need arose, supplies and maintenance facilities for tuna boats would be increased to meet the needs of a fleet wishing to base on the Gulf. Puerto Rico has harbors capable of handling the largest tuna boats, and at least a minimum of servicing and supply facilities are available to meet the trip needs of vessels ranging into the Caribbean.

Facilities for storage of frozen tuna in the Gulf Area are adequate to handle considerable quantities at some seasons of the year. Some competition for freezer space has been normal in the early winter and it is occasionally necessary for fish producers to haul fish several hundred miles for storage. Several conditions make it difficult to estimate the quantities of frozen tuna that could be handled without expansion of present storage space. Packaged products are preferred over bulk fish at the freezer plants, and demands for space are increasing. However, freezer operators in the Gulf Area generally express the opinion that facilities will be kept abreast of any gradually increasing requirement of a developing tuna industry.

Central Pacific Area

RECENT DEVELOPMENTS IN THE CENTRAL PACIFIC

Considerable knowledge has been gained concerning the occurrence and abundance of various tunas in the open Pacific in recent years. The Japanese, engaging in large-sacle fishing ventures in pre-war and post-war years, have located vast new mid-ocean productive grounds for albacore and yellowfin in the western half of the Pacific. Several Japanese mothership expeditions using long-line catcher boats, have operated in the central Pacific in the last few years. The Service's Pacific Oceanic Fishery Investigations staff is presently engaged in exploration and study of new tuna grounds in the equatorial eastern half of the Pacific. This investigation, which has been under way for 5 years, has revealed the existence of extensive stocks of yellowfin in waters south of Hawaii which can be readily caught with subsurface long-line gear. The exact extent of mid-Pacific tuna grounds which may be available can only be surmised at this time, but possibilities for further extension of offshore fishing areas are promising.

QUANTITIES AND SPECIES AVAILABLE

In the immediate vicinity of the Hawaiian Islands, a sizable resource of skipjack is fished by local vessels from May to October. Annual landings approximate 10,000,000 pounds. There is also a small population of surface yellowfin in the area during the summer months. A limited long-line fishery exists to supply the needs of the local fresh fish market. The outlook for expansion of this fishery is not bright as the abundance of tuna in the area appears to be much lower than in waters farther south.

In the Line Islands and Phoenix Islands, Pacific Oceanic Fishery Investigations has found fair quantities of surface yellowfin and some skipjack during the summer months. This area has possibilities of supporting a limited live-bait fishery. Inadequate knowledge exists concerning availability of surface tunas in the surrounding open ocean. Surface-swimming schools in this area can be readily taken by trolling as well as live bait, but efforts at purse seining them have been unsuccessful.

An exceptionally dense population of sub-surface tunas has been discovered by Pacific Oceanic Fishery Investigations explorations south of Hawaii in the general area from 140° to 160° W. longitude and from the Equator to 8° N. latitude. Long-line catches on experimental trips have ranged from 3 to 30 fish per hundred hooks, and average catches of 10 or 12 per hundred hooks have been made. This is exceptionally good fishing as compared to the Japanese and Hawaiian long-line fisheries. Primarily, these are large yellowfin tuna averaging over 100 pounds, with lesser amounts of big-eyed tuna and skipjack. The population is apparently subject to seasonal and possible other fluctuations in abundance, and it appears at present that the summer and fall are superior to other seasons.

The catch that could be expected by an American commercial fishing vessel using long lines in this area would depend to a great extent on the amount of gear the crew is willing and able to operate. Japanese crews of about 20 men fish approximately 2,000 hooks per day working extremely long hours, and a Philippine crew of 10 will fish about 600 hooks per day. It is impossible to project these figures into an American operation, but it does appear likely that an American crew of 12 could fish about 900 hooks per day assuming some slight improvements in the gear and methods of operation are made. An experimental trip with a converted Pacific coast purse seiner and a Hawaiian crew in August and September 1952 resulted in a catch of 96,000 pounds of tuna in approximately one month's fishing time. On the basis of catch rates on recent trips, the average daily catch for an American vessel and crew might be expected to range from 6,000 to 13,000 pounds in the most productive areas.

Albacore are known to be present in the offshore North Pacific past the range of the present fishery. Occasional catches have been made thousands of miles from land between Hawaii and the Pacific coast. Japanese long-line expeditions in the North Pacific extending as far east as waters north of Midway Island yielded productive fishing over wide areas. The American albacore fishery is shore-bound to the Pacific coast, and no organized commercial fishing and very little experimental fishing have ever been carried out in the vast expanse of water between Hawaii and California. Future exploration may reveal whether substantial stocks of albacore inhabit the waters of the eastern North Pacific gyral and if they are available there as they are further west in the Japanese fishery.

AVAILABILITY OF LOCAL FLEET AND FISHERMEN

The local Hawaiian tuna fleet, or portions thereof, would be readily adaptable to any expanded operations in the immediate vicinity. Limited range, capacity, and icing facilities of the fleet would necessitate a mothership or some shore-side facilities in the Line Islands or Phoenix Islands, where the resource is considered too limited for clipper-type vessels.

For exploitation of the large stock of sub-surface tunas in the equatorial region south of Hawaii, the small Hawaiian tuna fleet would be of limited value. It could be used only with some type of mothership support. Large seiners or clippers from the Pacific coast, adapted for long-line fishing would be needed for independent operation. Some local fishermen would be available to partially man such vessels.

AVAILABILITY OF BAIT

Limited supplies of bait are known to exist near the Islands, but final evaluation of abundance awaits long-term attempts to exploit the tuna resource. Some experimental trips to the Line and Phoenix Island Area have been hampered by the apparent inconsistency of available live bait. Bait does not present a problem to long-line fishing. Frozen sardines, herring and squid from the United States Pacific coast are all suitable for this type of fishing.

AVAILABILITY OF PORTS, PROCESSING FACILITIES AND MARKETS

Honolulu and the United States Pacific coast offer the only adequate port facilities for tuna fleet operations in the eastern mid-Pacific. Several suitable anchorages and docks are available in the area, but are without any logistic facilities. There is a dock in the lagoon at Palmyra and another at Canton. Nearly complete lack of facilities would necessitate shore-side construction or use of a mothership for any fleet which would use the Line or Phoenix Islands as a base of operations.

There is a limited market for fresh tuna in the Hawaiian Islands, and it is doubtful if this consumer market could be increased to any great extent in the near future. There are two tuna canneries, one on Oahu and one on Kauai Island. The most substantial potential market for any large-scale increase in mid-Pacific tuna landings appears to be the Pacific coast canneries, although Hawaiian canners could absorb considerable additional fish and, of course, are capable of expansion.

LIMITATIONS OF TERRITORIAL WATERS AND FOREIGN REGULATIONS ON THE UNITED STATES TUNA FISHERY

This particular subject is of great interest. Many phases of it have a most pronounced bearing on present fishing activity in the tuna industry. The subject is one that has received much publicity through newspaper reports of seizures of United States fishing vessels by foreign governments. It has also been the subject of endless discussion in many quarters and its delicate nature with respect to foreign relations can well be appreciated. Effective prosecution of fishing activity in the present areas of operation hinges on many decisions already made and yet to be made in this field. Considerable pertinent information on the subject follows. It has been carefully drawn together by staff investigators in cooperation with other government departments and the tuna industry. Only basic concepts are presented and no attempt has been made to go into the various minute details involved in the subject.

Vessels Affected and their Areas of Operation

With the growth of the tuna canning industry of southern California following the first World War, United States tuna fishermen expanded their range of operations -- first to waters off Mexico, then to Central and South America as far as northern Peru, and to the high seas off British Columbia during the past decade. The large area of operation is necessary in the maintenance of this year-round industry because of the migratory nature of tuna and their seasonal inconsistency of appearance. American fishermen have pioneered and developed this great fishery to its present place in our economy.

Because tuna are migratory fish, not bound to shore in any phase of their life cycle, most of the actual tuna fishing activities are carried on far outside the normal boundaries of so-called "territorial seas". There are related activities, however, which have lead to our tuna fleet regularly entering the territorial waters of Latin American countries; principally, search for tuna bait, use of port facilities, and, to a limited extent, actual tuna fishing. The three principal groups of American tuna vessels (albacore boats, purse seiners, and live bait boats or clippers) have been affected in varying degrees by the limitations and regulations of territorial seas of foreign countries.

Albacore are caught seasonally (summer and fall) off our own coastal States of California, Washington, and Oregon, with some fishing off British Columbia and Mexico. It is estimated that about 30 percent of the total albacore landings are caught off Lower California. Approximately 3,000 small craft from ports in Alaska to southern California fish part-time for albacore, spending the remainder of the year in other fisheries, such as salmon, halibut, bottom fish, sardines, etc. Some are equipped with live bait tanks (it has been estimated that one-third of the albacore are caught with bait, some of which is taken in foreign waters), but most employ surface trolling gear only. These vessels have a limited range and the bulk of their albacore catch is made from 20 to 200 miles offshore. Therefore, these fishermen are the least affected by existing foreign territorial sea claims.

The purse seiners, most of which are seasonally employed in both the pilchard and tuna fisheries, are generally larger than the albacore trollers, but more limited in range and facilities for preserving the catch than the clippers. Their normal area of operations, as indicated in an earlier section, is off southern California and Mexico, although some of the larger vessels may work as far south as the Galapagos Islands. There are about 15 large seiners which fish for tuna the year around in the same areas covered by the clippers. About 100 smaller purse seiners devote approximately 60 percent of their time to tuna, normally restricted to waters off Mexico (Real, 1952). Being free from the need of live bait, most of their fishing is done on the high seas, but a significant amount is also carried out in waters under the jurisdiction of foreign countries.

In the neighborhood of 200 long-range live-bait tuna clippers, using hook and line, operate on the high seas from southern California to the waters off northern Peru. Their total dependence on live bait and their wide range of operations have necessitated a certain amount of their time being spent in waters claimed by the various Latin American countries. These are the tuna fishing craft which have been vitally affected by territorial water claims and fishing regulations of foreign countries.

Foreign Territorial Sea Claims and Fishing Regulations

From Mexico to Peru there are 10 countries off whose coasts our tuna fleet operates. It is often difficult to establish the exact extent to which a nation claims the territorial sea or fisheries control in adjacent waters due to the ambiguity of the law or the frequencies of changes in the law with changes in administration. Claims to territorial seas which have been asserted (but not necessarily enforced) by these countries range from 3 to 200 miles, sometimes including contiguous zones established for various reasons (see Boggs, 1951).

Tuna bait fishes taken in these foreign waters are normally found within 3 miles of shore. Since the 3-mile zone of national sovereignty is commonly recognized and strictly adhered to by many nations (including the United States), the jurisdiction of these countries over the bait supply is unquestioned. Therefore, when fishing for bait or tuna in foreign territorial waters, American fishermen must abide by the regulations of the countries involved. Approximately fifty percent of the tuna bait is taken from the Mexican coast under Mexican fishing permits (Chapman, 1952). Some other countries which have bait resources available at certain times of the year and for which permits are issued include Panama, Ecuador, and Costa Rica. For detailed listing of regulations, license fees, etc., for the major bait areas, see the section on Foreign Licenses in this chapter.

The important point is that, with the exception of Ecuadoran permits, these fishing permits are used almost exclusively for taking tuna bait. Ecuadoran bait resources increased in importance following the discovery of new high seas tuna grounds off northern Peru. As is true of the other countries, Ecuador has tuna off her continental coast only at certain seasons, and in much greater abundance over a longer period of the year in the vicinity of the Galapagos Islands. American fishermen have, in the past, been able to purchase fishing permits from the Ecuadoran consul in San Diego which would allow fishing for tuna or bait in Ecuadoran waters, both near the Galapagos Islands and off the continental coast of Ecuador. These permits could also be purchased by the vessels at sea via radio. 19/ In addition to license regulations, several countries have provided, or expressed such intentions, for closed seasons on certain fishing grounds.

19/ In January, 1952, a change in Ecuadoran fishing laws eliminated "radio" permits and foreign fishing in the claimed territorial waters of continental Ecuador, resulting in a reduction in the number of permits purchased by United States tuna vessels. In September, 1952, the law was interpreted to make it possible for a vessel which had a Matricula aboard to radio in to San Diego for an Ecuadoran fishing permit, and have it mailed to any port except Ecuadoran. A Matricula is a permit to buy a license.

Relations with Foreign Countries and Causes of Disagreement

Because of the very nature of the American tuna fishery, then, it is not at all surprising that incidents have arisen involving American vessels and Latin American governments. Perhaps what is more surprising is the fact that, in general, relations between the American tuna fleet and the Latin American countries have been very good over a long period of time. Incidents involving charges of fishing law violations and invasion of territorial seas, with consequent vessel seizures and fines, have been relatively few, considering the number of fishing trips American vessels have made in these waters. Recent disputed tuna boat seizures have involved only one country, Ecuador. Such disputes, even though few in number, present a serious problem to our tuna fishermen and to our international relations.

At present, the problem of conflicting concepts and regulations respecting territorial seas, the continental shelf, and fisheries control, is under study by the International Law Commission of the United Nations (Francois, 1950, 1951, 1952). The Inter-American Council of Jurists of the Organization of American States has for some time been studying similar international law questions affecting the Americas. The problem is extremely complex, and there seems to be little hope for a quick solution covering the numerous and inconsistent national claims to territorial seas and sovereignty therein. The specific problems involving fisheries interests of the United States in international relations have for some time been under continuous study by the Department of State.

The three phases of international law which are of greatest importance to the American tuna fishermen are: (1) the extent of the territorial sea or fisheries jurisdiction claimed by the Latin American countries; (2) the location of base-lines from which such zones are measured; and (3) the right of "innocent passage".

Within accepted territorial seas, there is little question of the right of exclusive control of fisheries by the coastal State. Our tuna fishermen recognize this law, and have paid license fees and observed regulations of the foreign countries in whose waters they have had to operate. Incidents charging violations have usually arisen following drastic changes in regulations or closure of certain waters. Although the United States, along with Great Britain and many other major maritime nations steadfastly refuses to recognize claims of territorial seas in excess of 3-miles wide, in actual practice some countries are occasionally enforcing such claims (Mexico -- 9 miles, Ecuador -- 12 miles). American fishermen have observed such claims as a matter of expediency, not because they recognize them as valid. For practical purposes, exaggerated claims to territorial seas, such as 200 miles, have not been established at the present time. They have met with widespread opposition from many sources, for they are entirely out of reason and have no precedent. The difficulties involved in attempting to properly control such a vast expanse of water are recognized even by those countries involved. There has not been a great operational problem for the tuna fleet where such claims are not enforced.

As has been pointed out previously, the primary reason for American tuna fishermen to enter territorial seas of foreign countries is to obtain bait. The bait is found within the 3-mile limit, which is the minimum distance claimed by any country, and which is recognized by the United States. Therefore, as far as bait fishing is concerned, it makes little difference whether the claim to territorial seas is 3 miles or 12 miles. Any general extension of jurisdictional control beyond 3 miles could create serious difficulties in actual tuna fishing. Though most tuna are caught many miles off-shore, a significant amount is taken fairly close to the 3-mile limit in certain areas. Ecuador's enforcement of her 12-mile claim has caused inconvenience and added to the cost of tuna production in that area. Two recent seizures of American tuna boats 20/ in controversial waters have resulted in the United States Government protesting to Ecuador this interference with the rights of American vessels on the high seas.

20/ Sun Pacific seized July 29, 1952. Equator seized July 31, 1952. Both vessels were detained and fined.

The recent fishing dispute involving Britain's challenge of Norway's method of fixing base lines from which to measure the width of the territorial sea,[21] together with other adjustments of fishing zones by various countries, has focused interest directly on this problem. Recently Ecuador established a base line drawn directly between prominent points of her coast line which, in effect, extends the Ecuadoran claims of sovereignty far in excess of a 12-mile-wide band for most of her continental coast.

The right of "innocent passage" as applied to fishing vessels has been involved in at least one recent seizure of an American tuna boat.[22] Right of certain foreign vessels to navigate through the territorial sea of another country for the purpose of traversing that sea without entering inland waters, or of proceeding to or from inland waters, is a basic principle of international law. The United States position is that this right applies to fishing vessels as well as merchant ships.

21/ Norway's method of fixing base lines by drawing straight lines between prominent points of land instead of following the sinuosities of the coast line was upheld by the World Court.

22/ Notre Dame was taken into custody by Ecuador on November 4, 1951, for alleged violation of Ecuadoran waters and fined $5,376.20, which amount was paid on November 20, 1951, under personal protest of the captain. The United States Government has asked the Ecuadoran Government to reconsider the case charging that they have no right to deny innocent passage.

Outlook for United States Tuna Fishing in Foreign Areas

FACTORS INFLUENCING FUTURE DEVELOPMENTS

Before discussing the possible future effects of territorial sea declarations and fishing regulations on the United States tuna fishery off Latin America, it is important to point out that extremely confused and unsettled conditions surround the recent developments. The obvious political under-currents provide an even more hazardous basis for interpretation since policies change with administrations and are extremely vulnerable to pressures from nationalistic elements, private or nationalized industries, and political expediency.

It has been estimated that the tuna fleet spends $2,500,000 annually for fishing permits in foreign waters. While there are no statistics available, mention should be made of the large amount of money spent for fuel, provisions, and recreation in the many ports. This sum is substantial and may exceed the amount spent on fishing permits. Thus, American tuna fishing activities have provided a substantial source of income to these countries, which will have an important influence on future developments.

There has been a natural interest on the part of Latin Americans in the exploitation of the rich fishery resources that lie off their shores at certain seasons. Besides a desire to share in this source of wealth from the sea, apprehension over possible depletion of the fisheries has led to passage of restrictive fishing laws purportedly based on conservation. Actually there is no scientific information available concerning either the tuna or bait populations which can be used as a basis for an intelligent conservation or management program. The desire and ability of these countries to capitalize on tuna production will undoubtedly play a major role in future fishery legislation. Tuna are "seasonal" off each country, and to develop a full-time fishery, large vessels would be needed and this would entail fishing off the coasts of other countries at certain times. For a part-time tuna fishery to be successful, the fleet must be able to turn to other fishing activities in off seasons for which the vessels and crews would be suitable. This situation does not exist in many of these countries. Attempts to develop local tuna industries utilizing direct American aid and technical know-how have been undertaken. Some have been unsuccessful due to insufficient capital, poor management, political influence, and the lack of a suitable local fishing fleet. The continuation of efforts to establish nationally-owned industries is uncertain and will depend upon degrees of success achieved.

POSSIBLE ALTERNATE SOURCES OF BAIT

Depending on the location of seasonal tuna grounds, certain bait resources vary in importance at different times of the year. While there is little likelihood that all Latin American tuna bait grounds will be closed to American fishermen, there is always the possibility that some of them may be, through natural or other causes. Although some regulations have been instituted for professed conservation reasons, there is no evidence of a general decline in the bait resource from over-fishing. (At least one important local bait resource was temporarily destroyed by a natural disaster, "red tide"). United States tuna boat operators, in backing up their claim that they are not depleting the bait stocks, have cited records to show that they are presently fishing in every bait area in which they have fished for the past 25 years. The Inter-American Tropical Tuna Commission has begun a study of the tuna and bait populations with the objective of developing sufficient knowledge of the resource on which to base, if and when needed, recommendations for an effective management program.

It is estimated that approximately 50 percent of the tuna bait is taken from Mexican waters, and that, if necessary, these grounds could supply the needs of the entire tuna fleet. There is considerable bait available in waters off southern California which could also be utilized to a much greater extent than at present, in case of emergency. This would entail certain problems in transporting the bait to the more southern grounds, but is definitely a possibility. However, getting bait exclusively from Mexico or California would cause considerable inconvenience and result in an increase in total running time, for the clippers sometimes need two or more loads of bait on a single cruise.

Certain experiments designed to find a substitute for live tuna bait offer encouraging possibilities and have been discussed on previous pages . Experiments to develop gear for taking pelagic bait on the high seas may partially eliminate the importance of coastal bait grounds. Development of artificial bait fish is also being investigated. Other possibilities for eliminating the need of live bait from tuna fishing, although not advanced to any practical stage at present, lie in the field of electrical fishing and the utilization of sound impulses to arouse the feeding frenzy in tuna to the point where they will strike dead bait or artificial lures. Some of these possibilities are definitely encouraging others may be rather remote, but they do indicate that within the near future our tuna clippers might be wholly or partially free from their dependence on live bait supplies from waters of foreign countries.

POSSIBLE ALTERNATE TUNA GROUNDS

Expansion of the actual tuna fishing grounds reached the present southern limits of the fishery some 20 years ago, except for some seasonal fishing on the banks off northern Peru where United States fishermen began fishing three years ago. Areas which have been steadily fished for over 20 years are still producing record landings (Cary, 1952). Recent seaward expansion has led to tuna fishing as far as 200 miles or more from any land. Results of exploratory fishing by the Service's Pacific Oceanic Fishery Investigations indicate that subsurface stocks of tuna extend abundantly in a band of equatorial water for thousands of miles off the coast of Central and South America. (For other possible alternate tuna grounds seeprevious sections.Further exploration may lead to our tuna fleet operating as far as one or two thousand miles from shore but at no greater distances from California ports than the present southern limits of the fishery. The adaptability of tuna boats and crews to long-line fishing (discussed in another section) will undoubtedly have an important bearing on further seaward expansion. Thus, in the event of closure of some waters to United States tuna fishermen (even though entailing considerable inconvenience), there is evidence to indicate that sufficient stocks of tuna exist beyond 200 miles from shore to support the present industry.

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CHAPTER V -- PROCESSING

ABSTRACT

Tuna plants generally face on a dock where fish can be unloaded from the fishing vessel. Cannery space adjacent to the dock usually houses thawing and butchering facilities, and cold storage space, when available. Pre-cookers, and sometimes retorts, ordinarily adjoin this area. Cleaning and packing lines are usually located behind the pre-cookers. The labeling and packing room is often located on the floor above. Ordinarily rail facilities are available at the rear.

Fish are carried from the vessel to the plant either by sluices or by push carts, and are weighed between unloading from the vessel and arrival in the cannery. Conveying of fish is ordinarily handled in a highly efficient manner with little chance for improvement.

Tuna are thawed in running water in thawing tanks, or in air with or without sprays of water. Thawing time varies from a few minutes for nearly thawed fish to overnight for hard-frozen ones. Thawing operations require very little labor, and little if any improvement in efficiency is possible.

Tuna are butchered on small, stationary or movable tables, usually equipped with a moving belt, by from 3 to 10 or more men. One man generally slits open the fish, removing the viscera, a second man washes and smells the fish, and a third man places the fish in the precook baskets. In larger plants two such crews may operate. Additional men handle sluice gates and separate livers from the viscera. The butchering operation is conducted very efficiently at a cost rarely exceeding $2.00 to $3.00 per ton of fish.

Butchered fish are loaded into wire mesh baskets according to size. Baskets of fish of only one size group are arranged on wheeled racks, with an average of 700 pounds per rack, and pushed into the precookers. A precooker usually holds about three to five tons. Fish are cooked at 216° - 220° F. from 1-1/2 to 10 hours depending upon the size. Careful grading of fish by size within any one cooker minimizes the cooking problems. Plants giving adequate attention to this point obtain significantly better yields, as losses as high as 30 percent may occur during cooking and subsequent cooling. If the precook is shortened too much, the fish are very difficult to clean properly, and shrink excessively in the can.

Cooked fish are thoroughly cooled before cleaning, generally overnight in a screened rodent-proof room which, may be air-conditioned and temperature controlled.

Precooked and cooled tuna are usually cleaned on a conveyor belt at working table level. In the larger plants there may be 9 tables with 50 to 75 cleaners at each table. A fish is cleaned into quarters or loins. Flakes, suitable for packing, are collected at intervals. Workers are paid either on an hourly or piece-work basis.

The butchering and cleaning operations are the only ones in the entire canning process which have not been mechanized. The industry is working on several new processes to mechanize, partially or wholly, the cleaning operation. One or more of them, after further developmental work, may prove to be practical, and will probably materially reduce the cost of processing tuna.

Nearly the entire tuna industry has adopted the newly developed tuna packing equipment. For solid packing, the "Pack-Shaper" is used by most of the industry. The cleaned loins are fed by hand into a shaping tunnel composed of four belts. The loins are compressed into a cylinder of tuna which is pushed into cans, one at a time, and the correct thickness cut off by a knife. The Gorby and Davey machines have also been developed for this purpose. They are somewhat similar and utilize a measuring box.

Hand-packing labor costs about $.50 per case. The "Pack-Shaper" eliminates all of the packing labor except for the one to three persons who are required to feed the machine. Machine packing is used but royalty payments of at least 11¢ per case have to be paid, and there may be some loss in yield. To the expert, the appearance of the machine solid pack may be inferior to hand-packed fish because cans are not so tightly packed and the fish tends to have a slightly ragged cut surface. Developmental work is continuing toward elimination of these objections.

Both the chunk pack and the flaked or grated tuna are machine-packed by equipment specially designed for this purpose.

Salt is added by conventional type equipment. Hot oil is generally added at temperatures from 160° to 225° F.

Exhaust boxes, turret steam flow seamers, and vacuum seamers are used to create a vacuum in the cans.

Efficiency of can washing seems to be more a function of attention to operating details such as maintaining adequately high water temperature and use of sufficient detergent than to design of equipment.

Cans are labeled and boxed by conventional equipment, and storage is palletized with use of lift trucks.

Frozen raw loins and frozen cooked loins are two relatively new tuna products which Japan has shipped to tuna canneries in The United States in very limited quantities.

The frozen cooked loins, as received by the canneries, are thoroughly cleaned and ready for packing into cans. Practically 100 percent recovery from the loins can be expected if the present difficulties with oxidation can be eliminated.

The production of frozen loins, whether raw or cooked, offers several advantages. Plant operators in Japan benefit through additional processing activities. Since only the usable portion of the tuna is shipped, United States plants benefit from reduced shipping costs. Use of the imported cooked loins also will result in a substantial saving in labor costs since few, if any, of the plant personnel normally employed in the butchering, precooking, and cleaning operations will be required.

A newer product, which could seriously affect present tuna canning operations, is frozen, canned (unsealed), precooked tuna. A sample lot of the product was prepared in Japan by packing precooked and cleaned albacore meat in No. 1/2 tuna cans and freezing the open cans of tuna. The frozen product was then shipped to a cannery in the United States for completion of the canning process. The process may be subject to a United States patent.

AT LEAST 50 PERCENT OF THE WEIGHT OF THE WHOLE TUNA, AS LANDED, IS NOT CANNED. THE SO-CALLED "WASTE" MATERIAL IS USED TO PRODUCE LIVER, SOLUBLES, LIQUID FERTILIZER, TUNA OIL AND MEAL.

IN SOME PLANTS THE LIVERS ARE SEPARATED FROM THE OTHER VISCERAL MATERIAL AND PROCESSED INTO LIVER OIL. IN OTHER PLANTS ALL OF THE VISCERA, INCLUDING THE LIVERS, IS USED FOR THE PRODUCTION OF FISH SOLUBLES AND LIQUID FISH FERTILIZERS. THE REMAINING WASTE, INCLUDING FINS, HEAD, SKIN AND BONES, IS CONVERTED INTO TUNA OIL AND MEAL IN THE REDUCTION PLANT.

THE TUNA CANNING INDUSTRY UTILIZES ITS "WASTE" MATERIAL AS EFFICIENTLY AS ANY OTHER SEGMENT OF THE DOMESTIC FISHING INDUSTRY. EFFICIENCY IN TUNA CANNING MIGHT BE IMPROVED EITHER BY SAVING LABOR OR BY INCREASING THE YIELD OF CANNED FISH OBTAINED PER TON OF RAW FISH PROCESSED. SINCE SHORE LABOR AMOUNTS TO NO MORE THAN 10 TO 12 PERCENT OF TOTAL COSTS, CHANCES FOR MAKING ANY SUBSTANTIAL REDUCTION IN COSTS BY MORE EFFICIENT USE OF LBAOR ARE NOT GREAT. SUBSTANTIAL LABOR SAVING COULD BE ACCOMPLISHED IN THE CLEANING STEP IF ANY OF SEVERAL DIFFERENT PIECES OF EQUIPMENT WHICH ARE UNDER DEVELOPMENT TO CLEAN TUNA MECHANICALLY SHOULD PROVE SUCCESSFUL. A NET SAVING IN LABOR OF PERHAPS 25¢ PER CASE MIGHT BE ACHIEVED. OTHER STEPS IN THE PROCESSING OF TUNA ARE FULLY OR ALMOST FULLY MECHANIZED AND ANY IMPROVEMENTS WHICH MIGHT BE MADE COULD ONLY RESULT IN VERY SMALL OVER-ALL SAVINGS.

WITH THE COST OF THE RAW FISH AMOUNTING TO UP TO 70 PERCENT OF THE TOTAL COST, SAVINGS RESULTING FROM INCREASING THE YIELD OF THE CANNED PRODUCT ARE POTENTIALLY QUITE LARGE. OVER-ALL LOSSES DURING PRECOOKING AND COOLING MAY BE AS MUCH AS 30 PERCENT. THESE LOSSES MAY BE CUT DOWN CONSIDERABLY BY MORE CAREFUL CONTROL, BUT IF CARRIED TO AN EXTREME, MAY ALTER THE CHARACTERISTICS OF THE FINAL PRODUCT, AND RESULT IN A PACK OF POOR APPEARANCE WITH REDUCED PROTEIN CONTENT AND NUTRITIVE VALUE. SOME IMPROVEMENT IN YIELD IS POSSIBLE, NEVERTHELESS, AT LEAST BY SOME OF THE TUNA PACKERS.

ON THE WHOLE, THE TUNA INDUSTRY IS MAKING USE OF THE LATEST DEVELOPMENTS, AND IS OPERATING AT, OR NEARLY AT, MAXIMUM EFFICIENCY.

WHEN THE PRECOOK TIME FOR TUNA IS DRASTICALLY REDUCED OR ELIMINATED ENTIRELY, THE RESULTING CANNED PRODUCT DIFFERS FROM THE CONVENTIONAL PACK IN THE FOLLOWING PRINCIPAL RESPECTS:

1. CONSIDERABLY MORE AQUEOUS FLUID IS PRESENT IN THE CAN.

2. THE PROTEIN CONTENTS OF THE DRAINED FISH IS LESS.

3. THE CONTENT OF NATURAL TUNA OIL IN THE DRAINED FISH IS GREATER, BUT THE TOTAL OIL CONTENT (ABSORBED ADDED VEGETABLE OIL AND NATURAL TUNA OIL) IS LESS.

4. THE MOISTURE CONTENT OF THE DRAINED FISH IS GREATER.

5. THE TEXTURE OF THE FLESH IS SOMEWHAT LESS TENDER.

6. IF THE PRECOOK IS ENTIRELY ELIMINATED, CONSIDERABLE CURD OCCURS ON THE SURFACE.

THE TEXTURE OF MACHINE-PACKED FISH MAY BE SOMEWHAT DIFFERENT FROM THAT OF HAND-PACKED FISH. THIS RESULTS CHIEFLY FROM ABSORPTION OF A GREATER AMOUNT OF

OIL IN THE MACHINE-PACKED TUNA BROUGHT ABOUT BY A DISTORTION OF THE MUSCLE FIBERS OF THE FISH IN THE PACKING MACHINE WHICH IN TURN RESULTS IN A GREATER CAPACITY OF THE FLESH TO ABSORB OIL. THIS GREATER ABSORPTION OF OIL, IN SOME CASES, LEAVES INSUFFICIENT OIL AT THE SURFACE AND MAY CONTRIBUTE TO SCORCHING DURING RETORTING.

THE DRAINED FISH FROM OIL PACKS HAVE A MUCH HIGHER OIL CONTENT THAN DOES THAT FROM BRINE PACKS. THIS DIFFERENCE MAKES FOR A DIFFERENCE IN TEXTURE, WITH MOST CONSUMERS PREFERRING THE TEXTURE OF THE OIL PACK. THE TEXTURE DIFFERENCE IS NOT SO MUCH ONE OF DIFFERING TENDERNESS OR TOUGHNESS AS IT IS OF DIFFERING DEGREES OF OILINESS WHICH SHOW UP QUITE MARKEDLY IN COMPARATIVE TASTE TESTS. THE TESTS CARRIED OUT THUS FAR INDICATE THAT THE BRINE PACK USUALLY IS, IN ADDITION, A LITTLE TOUGHER THAN THE OIL PACK ESPECIALLY AFTER THE PACK HAS STOOD IN THE CAN FOR SEVERAL MONTHS. BOTH OIL AND BRINE PACKS DEVELOP SOME TOUGHNESS DURING THE FIRST FEW MONTHS OF STORAGE AFTER PROCESSING. A STATE OF EQUILIBRIUM SEEMS TO DEVELOP AFTER ABOUT SIX MONTHS OF SUCH STORAGE, WHEREUPON LITTLE FURTHER CHANGE OCCURS.

JAPANESE CANNED TUNA, BEING MOSTLY HAND PACKED, HAS A SOMEWHAT SMOOTHER SURFACE THAN THE AMERICAN MACHINE PACK. THE JAPANESE PACK SEEMS ALSO TO HAVE BEEN GIVEN A LONGER PRECOOK THAN IS CUSTOMARY WITH THE AMERICAN PACK, WHICH RESULTS IN THE JAPANESE PACK HAVING A SOMEWHAT HIGHER PROTEIN CONTENT THAN THE DOMESTIC PACK. HOWEVER, MOST OF THE CANNED TUNA IMPORTED FROM JAPAN IS NOW PUT UP IN BRINE, AND SUCH FISH HAVE A MUCH LOWER OIL CONTENT (AS LITTLE AS 2 PERCENT OIL OR LESS) THAN THE AMERICAN OIL PACKS (WHICH USUALLY HAVE FROM 10 TO 20 PERCENT OIL). SUCH JAPANESE BRINE-PACKED TUNA IS ALSO OF A SOMEWHAT TOUGHER TEXTURE.

FURTHERMORE, THE IMPORTED CANNED TUNA USUALLY HAS A FLAT, SOMETIMES ALMOST TASTELESS FLAVOR AS COMPARED TO THE DOMESTIC PRODUCT. THIS MAY BE DUE TO A VARIETY OF CAUSES, INCLUDING POSSIBLE LOSS OF FLAVOR CONSTITUENTS EITHER THROUGH HOLDING THE FROZEN FISH FOR TOO LONG A PERIOD OF TIME OR BY OVERCOOKING IT AT THE PRECOOK STAGE. THIS LOSS IN FLAVOR IS SOMETIMES QUITE NOTICEABLE.

THE STATE OF CALIFORNIA HAS EXTENSIVE REGULATIONS CONCERNING FRESHNESS OF RAW TUNA AND ADEQUATE PROCESSING METHODS IN PREPARING THE CANNED PRODUCT. THE INDUSTRY IS WELL SATISFIED WITH EXISTING REGULATIONS AND BELIEVES THAT THEY MAINTAIN THE QUALITY OF TUNA AT A HIGH LEVEL.

THE UNITED STATES FOOD AND DRUG ADMINISTRATION WILL BE BRINGING OUT NEW STANDARDS FOR CANNED TUNA WITHIN THE NEXT YEAR OR SO. HEARINGS ARE STILL IN PROGRESS CONCERNING CERTAIN CONTROVERSIAL ASPECTS OF THE STANDARDS, PARTICULARLY WITH RESPECT TO FILL OF CONTAINER.

FOR MOST CANNED FOOD PRODUCTS, THE AMOUNT OF FOOD MATERIAL PLACED INTO THE CAN ("FILL-IN" WEIGHT) CAN BE ESTIMATED BY DETERMINING THE "DRAINED WEIGHT" OF THE CANNED PRODUCT. IN THE CASE OF THE CANNED TUNA, HOWEVER, THE FISH ABSORBS VARYING AMOUNTS OF THE ADDED OIL DEPENDING ON THE TYPE OF PACK. THE MACHINE-PACKED TUNA ABSORBS MORE OF THE OIL AND THUS GIVES A HIGHER DRAINED WEIGHT THAN THE HAND-PACKED FISH. BECAUSE THE OIL IS NOT COMPLETELY REMOVED WHEN "DRAINED WEIGHT" IS DETERMINED, THE NEW TUNA STANDARDS WILL NOT BE BASED, AS IS COMMON WITH OTHER FOODS, ON "DRAINED WEIGHT"; SOME OTHER CRITERIA WILL BE USED. UNDER CONSIDERATION IS A METHOD OF MEASURING THE CONTENTS BASED ON "PRESS WEIGHT". THE CONTENTS OF A CAN WOULD BE SUBJECT TO A STIPULATED PRESSURE IN A SPECIAL PRESS, THE EXPRESSED LIQUID SEPARATED, AND THE AMOUNT OF PRESS CAKE (SOLIDS) DETERMINED. STIPULATED "PRESS WEIGHT" REQUIREMENTS WOULD HAVE TO BE MET BY EACH TYPE OF PACK SUCH AS SOLID, CHUNK, FLAKE, AND PACKED WITH OIL OR BRINE.

COLOR OF THE DIFFERENT PACKS OF CANNED FISH WILL BE GRADED IN THE NEW STANDARDS GIVING THREE TYPES, WHITE-MEAT, LIGHT-MEAT, AND DARK-MEAT PACKS. THE COLOR, DETERMINED IN A SPECIAL INSTRUMENT, WILL BE STIPULATED FOR EACH GRADE. IN ADDITION TO COLOR GRADES, PACKS MAY BE PUT UP AS SOLID-PACK, CHUNKS, AND FLAKES. SPECIFICATIONS MAY LIMIT THE AMOUNT OF SMALL PIECES ALLOWED IN THE SOLID AND CHUNK PACKS TO 15 AND 50 PERCENT RESPECTIVELY.

WHILE MANY PACKERS BELIEVE THAT THE EXISTING STANDARD TUNA PACK IS ALL THAT THE HOUSEWIFE NEEDS OR WANTS, NO LARGE-SCALE ATTEMPT HAS EVER BEEN MADE TO PUT UP A MASS PRODUCED TUNA PRODUCT CONSISTING OF TUNA AND SOME OTHER FOOD INGREDIENT(S) WHICH WOULD BE READY TO SERVE BY MERELY OPENING THE CAN AND HEATING. SEVERAL SUCH PRODUCTS HAVE BEEN TRIED ON A SMALL SCALE IN THE PAST, BUT WITH THE HIGH COST OF PRODUCTION (AND CONSEQUENTLY, HIGH SELLING PRICE) THEY HAVE NEVER BEEN POPULAR. ONE OF THE LARGER TUNA PACKERS IS NOW IN THE PROCESS OF BRINGING OUT SUCH A MASS-PRODUCED PRODUCT. A FEW MEMBERS OF THE TUNA INDUSTRY BELIEVE THAT SUCH PRODUCTS MAY GREATLY EXPAND THE DEMAND FOR CANNED TUNA, BUT UNTIL THE SUCCESS OR FAILURE OF THIS NEW VENTURE CAN BE DETERMINED, IT IS IMPOSSIBLE TO PREDICT THE FUTURE OF SUCH ITEMS. THE ARMED FORCES HAVE EXPRESSED AN INTEREST IN SUCH PRODUCTS AND, IF THEY WERE TO BE MADE AVAILABLE IN A SIZE OF CAN TO FIT THE UNITED STATES ARMY RATION CARTON, THERE MIGHT BE A CONSIDERABLE MARKET FOR THEM. HIGHLY SEASONED, SMOKED, AND OTHER SPECIALTY TUNA PRODUCTS HAVE BEEN PRODUCED FOR MANY YEARS IN SMALL VOLUME BUT PLANT OPERATORS DO NOT BELIEVE THERE IS ANY POSSIBILITY OF GREATLY INCREASING THEIR SALE.

SOME MEMBERS OF THE CALIFORNIA TUNA INDUSTRY ARE GIVING SERIOUS CONSIDERATION TO OPENING PLANTS IN PUERTO RICO. THE FAVORABLE TAX SITUATION GIVES THIS TERRITORY AN EDGE OVER ANY OTHER PLACE IN THE CARIBBEAN OR GULF AREAS. SOUTHERN CALIFORNIA HAS CERTAIN ADVANTAGES OVER MANY AREAS AS A LOCATION OF TUNA CANNERIES. IT HAS AVAILABLE OTHER SPECIES OF FISH WHICH ARE COMMONLY CANNED MAKING POSSIBLE A DIVERSIFIED YEAR-ROUND INDUSTRY WHICH INSURES A SUPPLY OF TRAINED PERSONNEL SKILLED IN THE VARIOUS OPERATIONS RANGING FROM CATCHING THE FISH TO PACKING THEM IN THE CANS.

JAPANESE-IMPORTED FROZEN WHOLE FISH IS PREFERRED BY MOST PACKERS TO DOMESTIC FISH BECAUSE OF CERTAIN HANDLING ADVANTAGES IN THE CANNERY. THE JAPANESE FISH ARE GRADED AS TO SIZE AND DAMAGED FISH ARE CULLED OUT BEFORE EXPORTATION. THESE FACTORS TEND TO MAKE THE JAPANESE FISH SEEM SUPERIOR TO THE UNGRADED, DOMESTIC LANDINGS. THERE IS A BELIEF IN SOME SEGMENTS OF THE INDUSTRY THAT THE COLOR OF THE JAPANESE FISH IS LIGHTER THAN THAT OF AMERICAN PRODUCED TUNA. THIS IS SOMETIMES ASCRIBED TO BETTER HANDLING OF TUNA BY JAPANESE THAN BY AMERICAN FISHERMEN. ACTUALLY SUCH BETTER HANDLING HAS NEITHER BEEN VERIFIED NOR, IN FACT, HAS ANY DIFFERENCE IN COLOR BEEN CONFIRMED. POSSIBLY THE FACT THAT A VAST MAJORITY OF IMPORTED TUNA ARE ALBACORE, A WHITE-MEAT SPECIES, HAS CAUSED PEOPLE TO BELIEVE THAT JAPANESE-CAUGHT FISH ARE ALWAYS OF A LIGHT COLOR REGARDLESS OF SPECIES.

JAPANESE-CAUGHT TUNA HAVE OFTEN BEEN HELD IN COLD STORAGE FOR MANY MONTHS BEFORE THEY REACH THE AMERICAN PROCESSOR. WHERE THE GLAZE HAS BEEN LOST FROM THE FISH, DEHYDRATION MAY BE MORE EXTENSIVE THAN WITH AMERICAN-PRODUCED TUNA. THE CANNED PRODUCT, RESULTING FROM SUCH DEHYDRATED FISH IS SOMETIMES DESCRIBED AS HAVING A WOODY TEXTURE AND BEING TASTELESS OR LACKING IN NORMAL FLAVOR.

This chapter will treat of the two principal activities in the tuna rocessing industry, canning of tuna and production of byproducts. As s been indicated in the chapter on consumption, there is not much demand for frozen, cured, etc. tuna products. The production of these items is so small in relation to the value of total processed tuna products that they will not be considered in this chapter. Canning of tuna and tunalike fishes is the one big activity in the tuna processing industry. The utilization of byproducts, while relatively smaller in economic value, is a function related to the canning process.

CANNING

The principal types of canned tuna and tunalike fishes produced by the domestic tuna processing industry have been discussed in some detail in the chapter on consumption. There, in the sections on pages 58 to 74, considerable detailed data are shown on the type of canned products packed by species, can sizes, etc.

Shore Plant Operation

The underlying purpose of this section of the report is to determine just how tuna is handled from the time it is received as fresh or frozen fish until it has been canned and stored for shipment. A consideration of the various steps in the canning process should then reveal whether any important engineering improvements might be made to improve efficiency of operation and reduce costs.

In carrying out this survey, each plant canning tuna in the United States was visited and thoroughly inspected. Fish were followed through each step of the canning process, and detailed notes were taken on operations of the equipment at each stage. In addition, superintendents and managers were interviewed. The geographical distribution of firms canning tuna and tunalike fishes in the United States is shown by States since 1923 in table 73.

The principal steps in the canning process considered and to be discussed in this report include (1) general arrangement of equipment in tuna plants, (2) conveying tuna to the cannery, (3) thawing of frozen fish, (4) butchering, (5) precooking, (6) cleaning, (7) packing, (8) addition of oil and salt, (9) exhausting and seaming, (10) cleaning and retorting of cans, and (11) labeling, boxing, and storage.

PLANT ARRANGEMENT

Practically all tuna plants are located adjacent to a dock suitable for unloading fish from a vessel and are provided with rail facilities for delivery of cans and other materials (sometimes including frozen fish).

TABLE 73.- NUMBER OF FIRMS CANNING TUNA AND TUNALIKE FISHES IN THE UNITED STATES, 1923 - 1952

YEAR	CALIFORNIA	OREGON	WASHINGTON	MAINE	MASSACHUSETTS	NEW YORK	MARYLAND	VIRGINIA	SOUTH CAROLINA	TOTAL
	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER	NUMBER
1923. . . .	19	-	-	-	-	-	-	-	-	19
1924. . . .	19	-	-	-	-	-	-	-	-	19
1925. . . .	22	-	-	-	-	-	-	-	-	22
1926. . . .	19	-	-	-	-	-	-	-	-	19
1927. . . .	19	-	-	-	-	-	-	-	-	19
1928. . . .	16	-	-	-	-	-	-	-	-	16
1929. . . .	17	-	-	-	-	-	-	-	-	17
1930. . . .	15	-	-	-	-	-	-	-	-	15
1931. . . .	15	-	-	-	-	-	-	-	-	15
1932. . . .	15	-	-	-	-	-	-	-	-	15
1933. . . .	12	1	-	-	-	-	-	-	-	13
1934. . . .	13	-	-	-	-	-	-	-	-	13
1935. . . .	14	-	-	-	-	-	-	-	-	14
1936. . . .	16	-	-	-	-	-	-	-	-	16
1937. . . .	15	2	1	-	1	-	-	-	-	19
1938. . . .	15	3	1	-	1	-	-	-	-	20
1939. . . .	16	6	3	-	1	-	-	-	-	26
1940. . . .	16	6	3	-	2	-	-	-	-	27
1941. . . .	18	6	3	-	1	-	-	-	-	28
1942. . . .	19	6	1	-	1	-	-	-	-	27
1943. . . .	18	9	2	-	-	-	-	-	-	29
1944. . . .	18	9	5	-	-	-	-	-	-	32
1945. . . .	20	14	9	-	-	-	-	-	-	43
1946. . . .	22	14	11	-	-	-	1	1	-	49
1947. . . .	32	14	13	-	1	-	1	-	-	61
1948. . . .	30	13	14	2	3	1	2	-	-	65
1949. . . .	31	10	9	2	2	-	2	-	-	56
1950. . . .	27	11	9	2	2	1	1	-	1	54
1951. . . .	28	9	6	1	1	-	1	-	1	47
1952. . . .	27	6	7	1	1	-	2	-	1	45

as well as for shipment of the final canned product. Usually the cannery faces the dock with the rail line at the rear. Ordinarily, a doorway opens from the dock side of the plant into a room where the fish are thawed and butchered. If thawing tanks are employed, these may be in this or in an adjoining room. If a cold storage is available on the premises, it is generally adjacent to and entered from this room. The fish are usually delivered to an open space near the door and if frozen are merely laid on the floor for defrosting with or without sprays. The butchering table, sometimes permanently installed, in other cases on casters for moving about, is usually nearby. The racks and baskets are generally assembled in an area near the butchering table and the perforated papers (if used) inserted in each basket before it is wheeled to the end of the table to be loaded with fish. In most plants the precookers, and in some cases the steam boiler, are located in space adjacent to the butchering room. A typical tuna plant layout is shown in figure 15.

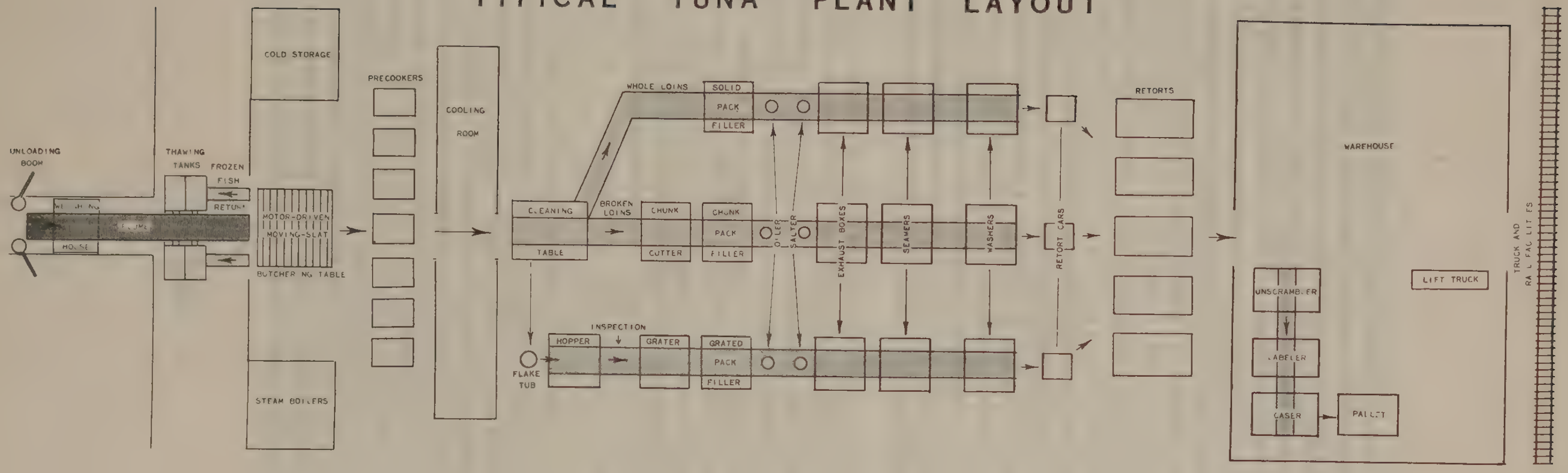
In most cases, the cleaning, packing, and seaming equipment are located in space directly behind the thawing and butchering room. In a few plants butchering is carried out at a different floor level than the other operations. In the ideal layout (where space permits) the cleaning, packing, and seaming operations take place in straight lines. In the larger plants as many as nine such lines are employed while the smaller plants may have only one or two. Where many lines are operated, it is common to reserve several of them for putting up special packs such as flakes or chunks. Flakes, in such plants, are almost invariably put up in separate lines. Chunk pack may be put up in the same line as solid pack with provision to divert cleaned loins to alternate fillers and seamers. In smaller plants having only a very few lines, the arrangement has to be very flexible so that the same lines can be used for different purposes when different types of packs are being put up. Considerable ingenuity is used in some of the small and medium-sized plants to achieve maximum flexibility in use of the equipment for different types of pack.

After seaming, cans are washed. Usually a separate washer is placed at the end of each line immediately after the seamer. In a few of the plants a single large washer was employed through which conveyor chains containing cans from all the lines passed. From the washer the cans are conveyed to the retorts and then to the labeling and boxing area.

Cans are generally labeled and boxed in a room at the rear of the cannery which is adjacent to or part of the storage room. In most plants this room has access to a spur railway line at the rear of the plant.

Figure 15

TYPICAL TUNA PLANT LAYOUT


UNLOADING BOOM
WEIGHING HOUSE
FLUME
THAWING TANKS
FROZEN FISH
RETURN
COLD STORAGE
MOTOR-DRIVEN MOVING-SLAT
BUTCHERING TABLE
STEAM BOILERS
PRECOOKERS
COOLING ROOM
CLEANING TABLE
WHOLE LOINS
BROKEN LOINS
CHUNK CUTTER
SOLID PACK FILLER
CHUNK PACK FILLER
FLAKE TUB
HOPPER
INSPECTION
GRATER
GRATED PACK FILLER
OILER
SALTER
EXHAUST BOXES
SEAMERS
WASHERS
RETORT CARS
RETORTS
WAREHOUSE
UNSCRAMBLER
LABELER
CASER
PALLET
LIFT TRUCK
TRUCK AND RAIL FACILITIES

U. S. FISH AND WILDLIFE SERVICE

In quite a number of the plants the labeling, packing, and storage section is on a floor above (and usually behind) the rest of the plant. It is common also to use this same area for unpacking empty cans and by means of unscrambling devices to arrange them in conveying lines and feed them to the filling machines. This makes a convenient and efficient set-up whereby empty cans can be brought into the plant from the rail line, and finished cartons of canned tuna shipped out without in any way interfering with other operations in the plant.

CONVEYING SYSTEMS FOR CARRYING TUNA TO THE PLANT

The larger canneries which are located adjacent to docks and have no intervening roadway or other obstruction use, as a rule, the following system. A large tub is lowered through the hatch into the hold of the fishing vessel and filled by hand with tuna. The tub is then lifted out of the hold by a boom hoist and swung over an apron where it is dumped automatically with a catch chain. In some installations two hatches of a single vessel can be unloaded simultaneously in this way.

The fish fall from the dumping apron into a flume containing running sea water which sluices the fish on to a slat-type conveyor belt elevator which lifts the fish to a scale house where the fish are weighed, usually in the presence of representatives both of the fishing vessel and of the cannery. The weighing is done in batches, ordinarily a scale hopper of about 700 pound capacity being employed. The fish are then sluiced through flumes to the cannery. This method is highly efficient and involves a minimum of handling. It is used by the large plants in San Diego and by one Terminal Island plant. Such a system can handle about 15 tons per hour.

Most of the plants on Terminal Island are located across a roadway from the unloading docks making the use of continuous sluiceways for conveying the fish to the plants inconvenient. A majority of these plants make use of three-wheel metal carts holding around 1,000 to 1,400 pounds of tuna. These carts are lowered into the hold of the vessel, filled with tuna, and then lifted by boom, or in some cases, by overhead trolley with chain lift on to the dock. Otherwise, a large bucket, usually with a hinged bottom, is loaded with fish in the hold and dumped into the cart on the dock. The cart is then wheeled over a floor level weighing scale and into the cannery. This method, although requiring a little more labor than the sluicing method, is reasonably efficient.

Some tuna are brought to the cannery by other transportation methods than by the fishing vessel. In a few instances the fishing vessel discharges tuna at some remote port and the iced fish are hauled to the cannery in large truck-trailers. The trucks are then unloaded, usually into the carts, which are wheeled into the cannery. Japanese tuna are often unloaded at points such as Portland, Oregon, or Seattle, Washington where they are placed in cold storage. The fish, when needed at a cannery, are packed into a truck or freight car and shipped to the cannery. Usually the fish are unloaded from freight car or truck into hand-pushed carts and wheeled into the thawing or butchering room. The extensive handling and re-handling of such frozen fish may result in quite serious bruising, abrasion of the skin, or other damage. Frequently, the workers in unloading a car or truck of such fish handle them with hooks. While an effort is usually made to handle the fish by the head or tail, occasionally fish are hooked through the body and, if the fish are partially thawed, considerable damage may result. When the fish are, as sometimes happens, handled as many as 4 or 5 times in this way, an appreciable portion of the fish may show the effect of such rough treatment.

In general, the conveying of fish from vessel to cannery is handled in a highly efficient manner with a minimum of labor. It is not believed that any considerable improvement can be made at this stage.

THAWING FROZEN FISH

Fish frozen aboard clipper ships are generally thawed or partially thawed before they are unloaded at the cannery. It is customary to turn off the refrigeration a day or two before the vessel docks. In some cases sea water is circulated through the coils in the wells containing frozen fish to hasten thawing. Thawing or partial thawing of fish aboard the vessel facilitates unloading without the danger of breaking or otherwise damaging the fish when they are removed from storage on the boat. (Frozen fish are more easily damaged than thawed ones because of the greater tendency for them to stick to the coils or to each other; in handling during unloading such fish may be damaged when they are pulled apart.) It also reduces the thawing time required at the cannery. It is generally impossible to completely thaw the fish aboard the vessel because this would entail too much danger of spoilage should there be a delay between the time the fish are unloaded and the canning process begins.

Fish unloaded by sluicing generally go directly to the butchering area. It is common to have an arrangement whereby fish not sufficiently thawed can be diverted by opening a gate so that they are sluiced into a thawing tank. After these fish have finished thawing, they are released back into the sluiceway which carries them again into the butchering room.

Thawing of fish in tanks is generally done only in the larger plants. More frequently the fish are allowed to thaw by spreading them in a single layer on the floor and allowing them to thaw either without other aid or more frequently by sprays of water from an overhead pipe spray system. In a few plants the fish are placed in piles and thawed by spraying water from a hose at intervals. Even some of the larger plants use spray rather than tank thawing.

Since fish are in such a variety of stages of thawing, from hard frozen to completely thawed when they reach the plant, thawing time varies over a wide range. Very frequently, even though the fish were originally frozen aboard the vessel, they are sufficiently thawed by the time they reach the butchering table that they can be butchered forthwith. In many other cases the relatively short wait from the time they reach the butchering room until actual butchering starts is sufficient to complete thawing.

For hard-frozen fish, thawing overnight with sprays is generally employed which is in most cases sufficient to thaw the fish. Fish from a vessel are seldom hard-frozen when they reach the plant. In some instances canneries have cold storage rooms in which surplus fish are placed. Such fish can be withdrawn at a suitable time so as to be thawed when canning operations start.

It was noted in some instances that fish thawed in tanks apparently lost some weight due to the leaching action of the water. At least the water in several such tanks was quite cloudy. Investigation of this possibility might be worthwhile since only a small loss of fish at current fish prices is sufficient to seriously run up operating costs.

The amount of labor used in thawing fish even in the plants using the most inefficient set-ups is trivial. Usually men assigned other duties incidentally take care of the thawing operations. Especially in view of the wide variation in degree of hardness of fish to be thawed, employment of any special thawing equipment would not seem feasible.

DRESSING OR BUTCHERING

Butchering of tuna takes place along a butchering table. Frequently a slat conveyor belt, 30 to 36 inches wide, carries the tuna along such a table, and the various operations are conducted by men stationed along one or both sides of this table. A small plant might have as few as three men at such a butchering table. The first man would slit open the fish and remove the viscera. The second man would wash the fish body cavity, smell the fish to reject any spoiled tuna, and remove any bits of viscera overlooked by the first butcher. The third man would load fish into the baskets for precooking. A somewhat larger plant might have three men stationed on each side of the table carrying out these operations. In the smaller plants the butchering tables are not usually equipped with the moving belt conveyor.

In still larger plants more men are employed. A typical set-up in such a plant might include one man to operate the flume to divert fish to the butchering table, a man to check on the degree of thawing and divert still frozen fish to thawing tank or space, a third man to butcher the fish, a fourth man to remove livers from the viscera, a fifth man to wash and smell the fish, and two or three basket fillers. In the larger plants two butchering crews, one working from each side of the butchering table,are often used.

In some plants the butchering table is on casters and can be moved about wherever it is handiest for the day's operation. The portable table is quite efficient where floor thawing is used as the table can be pushed directly into the individual piles of fish.

The cost of butchering is hard to estimate because of the practice in many plants of having butchers assist in other operations in the plant. Possibly an estimate of $2.00 per ton, covering all steps of the butchering process until the fish are placed in the baskets, would be about average. Some plants estimated butchering costs to be as high as $5.00 per ton but in such cases the butchers usually assisted in other operations about the plant.

There seems little that can be done to improve efficiency of the butchering operations. The labor cost for this step is relatively low, and installation of complicated butchering equipment would not seem warranted even if it would be developed unless it were contemplated to change the entire tuna canning procedure.

PRECOOKING

During precooking and coolimg, shrinkage takes place amounting up to 30 percent of the weight of the tuna. Two-thirds to three-fourths of the loss occurs during cooking and the balance during cooling of the fish. This is caused by loss of oil, solids, and moisture during cooking, and loss of moisture due to evaporation and drip during cooling of the fish. Since the cost of the fish represents about 70 percent of the processors cost, any savings in the shrinkage occurring during precooking and cooling is of the greatest importance.

The butchered tuna are placed in wire baskets with a capacity of 30 to 35 pounds which will hold from one to five or more fish (very large fish may have to be cut and placed in several baskets). In most plants a layer of special heavy Kraft paper perforated with holes and treated to withstand moisture is laid on the bottom of the basket and the fish is placed on the paper. This minimizes marking of the fish by the wire of the baskets and makes it easier to remove the fish by preventing sticking of the fish to the basket. The holes in the paper allow juices and oil to drip away. The baskets are placed on racks (usually 14 baskets per rack, though larger racks may hold 21 baskets), and the racks are mounted on wheeled carts which are rolled into the cooking ovens. A rack holds about 700 pounds of tuna and a cooker will usually hold 9 to 16 racks (about 3 to 5 tons). Double-width cookers hold twice these amounts. The cookers are made of sheet iron supported by iron frames and usually are of rectangular cross-section about 6-1/2 ft. x 4 ft. and 12 ft. to 20 ft. long. Racks are introduced through a door in the front and when cooking is completed, are withdrawn through the same door. In double-ended cookers racks are pushed in the front, and upon completion of the cook, go out a door at the rear. A few plants use improvised cookers by employing standard retorts.

The cooked fish must cool thoroughly, a process usually requiring about 24 hours. The racks are placed in a separate room or space and allowed to stand, usually overnight. In a few plants air circulation is provided and in one plant refrigerated air holds a constant temperature regardless of outside weather conditions.

In the precooking operation as much as 20 percent of the weight of the fish is lost. This consists of tuna oil, moisture, and dissolved protein and other tissue constituents. It is desirable to keep the moisture loss consistent from fish to fish and avoid excessive over-cooking with resultant large shrinkage losses. Large fish require longer precook times than do smaller fish. Hence, it is customary to grade fish according to size, placing fish of only one size grade in a given cooker, and to vary the cooking time in proportion to the size of fish in the cooker. This avoids overcooking the small fish in order to sufficiently cook a few large ones. Usually fish are divided into not more than three categories, large, medium, and small. This still leaves a fairly wide variation in size of fish in any cooker. Some plants use more size grades which results in more uniform cooking and less shrinkage losses by overcooking. Close attention to cooking time and temperature also pays off in large savings of shrinkage loss. Some plants run check weights on tuna in each cooker weighing fish before and after precook to be certain that losses do not exceed pre-determined limits. Many plants also have temperature recording instruments on each cooker to be certain that temperatures are accurately maintained.

Tuna are precooked in most canneries at temperatures usually between 216° and 220° F. The time of precooking varies with the size of fish and also from cannery to cannery. The following tabulation is typical of cooking times used:

Size of fish	Number of fish per basket	Cooking times in hours
Very small	8 or more	1-1/2
Small	6 - 8	1-3/4
Small to medium	4 - 6	2 - 2-1/2
Medium	3	3 - 4-1/2
Large	2	6 - 8
Very large	1	8 - 10

In a few plants it was observed that there seemed to be a tendency to reduce the precooking times apparently in an attempt to increase the yield of fish by not cooking out so much moisture.

The racks and baskets used in the precookers rapidly become covered with a coating of fish protein and hardened fish oil unless constant effort is maintained to keep them clean. Some plants steam clean this equipment after each cooking operation. The use of paper liners in the baskets is a help in reducing on the severity of this problem as it keeps fish away from the metal baskets thus eliminating much of the tendency for fish particles to adhere to the basket. It also provides a fresh surface on which the fish rests regardless of whether the basket was completely clean at the start of each cook.

While it is not believed that any simple improvement in precooking equipment and methods would greatly improve efficiency of operations, there is room for improvement in some plants in the care taken to obtain a uniform cook. Saving of just 1 percent of the total maximum of 30 percent shrinkage loss during cooking and cooling would be well worthwhile. Such, or even much larger, savings are being made in many of the plants by careful attention to cooking temperatures and times and by more careful sorting of the fish by sizes.

Careful control of precooking time means not only avoiding overcooking, but also making certain that the fish are not undercooked. Insufficiently cooked fish are very difficult to clean and greatly slow up the rate of cleaning. Furthermore, under-precooked fish make a poor appearing pack because of the tendency of the fish to shrink excessively during final retorting in the can.

Losses during cooling of the precooked fish amount to as much as 10 percent. Much of this is evaporation of moisture from the hot fish. Maintenance of high humidity in the cooling areas will reduce such losses and some plants are experimenting along this line in order to keep shrinkage during cooling to a minimum.

CLEANING

The cleaning of tuna requires more hand labor than all other shore operations combined. It is the one stage of the entire canning operation, aside from the butchering operation, which has not been completely mechanized. It is for this reason that changes and improvements in cleaning methods may be expected to yield the biggest labor savings of any single operation. Savings might be obtained either by making the existing procedure more efficient or by replacing the existing methods with some more highly mechanized procedure. The tuna industry is working along both these lines in an effort to improve the efficiency of the cleaning operation.

Existing practice varies somewhat between the most efficient canneries and some having older equipment. The following is typical of operations in the larger and more modern plants. Fish are cleaned on long cleaning tables having workers on both sides with, in a typical installation, 50 to 75 cleaners to a table. Several such tables are operated in a large plant.

A modern cleaning table generally has three moving belts. The upper belt is used for conveying the cleaned loins to the packing machine. The middle belt conveys the whole fish to the cleaners. At one end of the table, racks containing baskets of precooked tuna from the cooker are unloaded on to the middle belt and the tuna conveyed the length of the belt and removed as required by the cleaners on each side of the table. The lowest belt, which moves in the opposite direction from the other two, is connected to the table top by open chutes opposite each cleaner. Waste and parts of tuna unsuitable for the grated pack are discharged into these chutes and are carried back to the beginning of the line and thence by a conveyor to the meal and oil plant. The table work top is on a level with the middle belt so that the heavy tuna can easily be slid from the belt to the worker without undue lifting.

When tuna are to be hand-packed, the cleaned loins go on to boards (about 26" x 18") which carry tuna on a belt to the guillotine knife. If the fish are to be machine-packed, these boards are not used; and the loins are placed directly on the moving belts.

In cleaning the fish, the head is removed and the skin and fins scraped off. The fish is split, and the backbone removed. Each half is split again longitudinally and the dark meat carefully scraped away. The flakes suitable for canning are placed in large pans. The content of these pans is usually emptied into a larger container on a cart which is rolled along the line by a worker who carefully inspects the flakes before collection in order to be certain no fins, bones, skin, or other undesirable constituent is present. Sometimes an inspector also works at the end of the lower belt just before the refuse enters the conveyor to the reduction plant. He removes any edible flakes which may have been carelessly or accidentally dumped on to the refuse belt.

In the larger plants containing a number of lines, some may be used for chunk pack and others for solid pack. Usually one or two separate lines are always used for packing the flake and/or grated pack.

In smaller plants the cleaning operation is nearly the same except that shorter and fewer cleaning tables are employed. In almost all plants a moving belt is used for conveying the whole fish to the cleaners.

In a few plants the racks containing baskets of precooked fish are stationed between the rows of cleaning tables, and workers carry baskets of precooked fish are stationed between the rows of cleaning tables, and workers carry baskets of tuna to the cleaners, as required. In a number of the smaller or older plants, especially where hand-packing is used, the boards of cleaned loins are carried by hand to the guillotine and packing line.

The rate at which fish can be cleaned varies with the skill of the worker and the size of the fish. A greater weight of fish can be cleaned if the fish are large than if they are small. In labor contracts between unions and the canneries, standards of the rate of cleaning are sometimes set. Thus in the Columbia River area a standard of eight fish per hour is mentioned. However, if a good job of cleaning is done, seldom are more than six albacore cleaned per hour. It is to the advantage of the cannery to see that the cleaner does not work so fast as to be careless about turning out a well-cleaned tuna loin, to produce more flakes than are absolutely necessary, or to discard flakes in the waste chute. Some canneries use piece-work rates with a bonus for production above a minimum quota while other canneries operate strictly on an hourly rate. Although the piece-work rate results in greater output per worker, it generally produces a definitely inferior product with greater loss or diversion of a portion of what should have been solid pack pack to the flake pack. An increase in yield (due to the high proportion of operating cost being charged against cost of fish) is much more important than a proportionate increase in cleaning rate. Thus, a simple calculation shows a loss of an extra 1 percent of fish going into the waste chute will not compensate for an increase in cleaning rate of 20 percent.

Where piece-work is employed closer inspection is a necessity. In some plants inspectors or supervisors travel up and down the cleaning line inspecting the output of each worker, and in addition loins, flakes, and waste are separately inspected to prevent waste.

Costs of the cleaning operation (estimated from information furnished by plant superintendents) varied from about 33¢ per case in the most efficient plants to about 55¢ per case in the less efficient plants. Possibly an average of 45¢ per case might be typical. These figures are for yellowfin tuna. When skipjack tuna is processed costs are much higher owing to the small size of this species.

Only a few years ago all tuna was hand-packed, an operation requiring an amount of labor next in quantity to cleaning. Today a majority of plants employ machine-packing. The tuna industry is giving considerable thought to ways and means whereby the laborious hand cleaning operation can be mechanized. This is not an easy problem to solve. In addition to the need for the developing equipment to separate the flesh from bone and skin, it is necessary to devise means of removing dark from light flesh. If this is done by removing the dark flesh by some mechanical device based upon the usual location of the dark strips of flesh, considerable light meat will be removed with the dark owing to variation from fish to fish. This then poses the problem of hand-labor to separate the dark from light meat or the alternative of reduction of yield of light meat. The industry is working on several mechanical devices which may eventually work out into a practical method of cleaning tuna.

PACKING

Three chief types of pack of tuna are put up. The solid pack is composed of transverse segments usually not exceeding three to four to the can. In the chunk pack the loins are cut into smaller segments before filling into the can. Flake or grated pack consists of small pieces most of which will pass through a ½-inch screen.

Solid Pack

Fitting together of three or four segments of tuna in a can to form a neat appearing, solid pack is a fairly complex operation. Until the past few years such filling was always carried out by hand and even now a few machine packers will, on special order, put up a hand pack which is considered of superior quality to the machine-packed product.

For the hand pack, cleaned loins on boards pass beneath a guillotine-type cutter consisting of a heavy knife blade suspended above and at right-angles to the conveying belt containing the boards of tuna loins. The knife moves up and down at a rate geared to the forward motion of the tuna loins and such that segments about 1-1/8-inch wide are cut for the usual 301 x 113 tuna cans. Generally three pieces of fish are fitted into the can to form a solid surface around the circumference and throughout the can. Where necessary a fourth small piece may have to be added. These operations ordinarily take place on each side of a long packing table. Such a table in a typical operation might consist of an upper belt containing boards of cut tuna loins. Beneath would be a second moving belt containing the empty tuna cans which can be slid off the belt on to an adjacent shelf by the packers as needed. Beneath the can belt is a third moving conveyor at work-bench level for delivery of filled containers. At the end of the packing line is a patching table where cans are usually inspected and where necessary additional fish can be added. About 40 hand packers work on one line.

Most of the tuna industry has replaced hand packing with completely automatic filling machinery, generally using the Carruthers "Pak-Shaper". This machine is the final development of a device originally known as the Pak-Selector, on which work was started in 1940 by Ebin Carruthers. The Pak-Selector, an ingenious though rather cumbersome mechanism, gave way to the present more simple and rugged Pak-Shaper. This machine molds loins of tuna into a uniform, cylindrical form and cuts off segments, strictly on a volume basis, and feeds them into the cans.

Essentially the Pak-Shaper consists of two separate feed chains, each chain link fitted with a semicircular steel plate with each plate overlapping the following plate like fish scales. The two chains lie in a horizontal plane and side by side. The driving sprockets of each chain operate, one with clockwise rotation and the other counter-clockwise when looking downward upon the feed chains. Thus, the sides of the two chains nearest each other move forward in the same direction and the semicircular chain attachments, as they approach the other chain, form a round tunnel which approximates the shape and size of the cross section of the tuna can. The bottom of this tunnel consists of the steel belt upon which the fish rests. The top of the tunnel consists of a moving belt eventually converging into a stationary plate.

As the chains move forward, the tuna loins are received at the entering end where the feed chains are widest apart, and the loins are fed into this receiving end on a steel belt. The feeders, one to three girls, stagger or overlap the loins to form a uniform column of fish as it enters the machine. As the chains move forward, the fish is gradually compressed by having the chains approach nearer each other forming a round cylinder approximating the size of the can. This pressing and forming is aided by two tampers on each side of the feed chains which aid in kneading the fish into the proper shape. The column of fish is extruded through a forming ring which sizes the column to conform exactly to the size of the can.

As soon as the fish has moved the proper distance past the forming ring, a circular knife descends and cuts off the in-fill section to the exact length required. The circular knife then moves forward at a higher speed than the incoming fish and places the severed cut into the waiting can which rests in the can turret. The turret steps forward one place bringing an empty can into place, the knife moves upward out of the way of the incoming fish and back to its first position next to the forming ring ready for a new cut, and the cycle is completed. The speed of the machine is around 120 cans per minute. One to three workers may be used to feed the machine; three feeders producing a much better product than when one feeder is used. The skill of the feeder also has a great bearing on the quality of work put out by the machine.

This machine replaces about 40 hand packers and only one to three workers are required to operate it. Offsetting a portion of the saving in labor is the royalty charge which starts at 19¢ per case for the first 25,000 cases, decreases to 14¢ per case for 25,000 to 50,000 cases, and amounts to 11¢ per case for all packs exceeding 50,000 cases. A $5,000 minimum charge is made for small packers who use the machine regardless of the amount of fish packed. Hand packing may cost as much as 50¢ per case so that the saving by machine packing, even after the payment of royalties, may be considerable.

The pack obtained by the use of the Pak-Shaper, as generally operated, is considered by many to be inferior in appearance to a hand pack. The pieces of fish resulting from the staggered several loins being pushed together in the tunnel do not fit together quite so well as hand packed fish. This leaves a small open space between pieces especially near the center of the can. Immediately after emerging from the packer this difference is not so apparent but after processing in the retort, shrinkage takes place and this failure to completely fill the center of the can shows up. Another difference results from the fact that the circular knife which cuts off lengths of tuna for each can, does not always make such a clean cut as does the guillotine knife used for the hand packs. The surface may have a jagged appearance from this cause. Often small shreds of fish will be found floating in the oil, when the can is opened.

A different type of change caused by the machine pack results from the twisting of the fibers of fish while the loins are in the packing tunnel. The distorted fibers permit more of the added soya oil to be permanently absorbed by the fish than is the case with hand-packed fish. When a drained weight of the contents of a machine-packed can is taken a part of this absorbed oil does not drain away and a higher drained weight is obtained than would have been the case had the same fill-in weight been used for a hand pack.

A still further difference between machine and hand-packed fish concerns losses during packing. In the machine pack, the fish in the tunnel becomes rather severely compressed and some juices may be squeezed out. The inner sides of the belt forming the tunnel are washed by sprays of water and any juices pressed out of the fish go down the drain with this spray water.

The Carruthers Co. is working on improvements to its equipment and have plans for producing a modified model which, it is anticipated, will overcome many of the problems encountered in use of the present model.

Two other packers are also used, one in each of two plants. The Keystone or Gorby Machine makes use of a measuring box. Tuna loins are placed upon a flat belt of such a width as to accomodate two loins side by side. Two vertical side belts form a moving chamber which continually advances the tuna loins forward. The loins are placed into this moving chamber side by side and overlapped or staggered to form a uniform cross section of fish.

The belts move the fish forward under a compression roller which aids in forming a solid space-free column of fish. The column of fish comes up against a backstop and a guillotine knife, set at right angles to the feed belts, descends and cuts off the exact length of fish required

While the knife remains down, a pusher piston moving at right angles across the belt, transfers the severed section between the knife and the backstop into a short tunnel and thence into a pocket or measuring box on the periphery of a turret containing a number of such pockets. The pressure of this pusher piston can be adjusted to predetermine the solidity of the fish going into the can and thus its weight. While the pusher holds the fish into this measure box, a knife cuts off the charge which now becomes the in-fill weight for the can.

The turret moves around one step, the pusher returns to its original position, the guillotine blade lifts, and the belt moves the column of fish up to the backstop thus completing the cycle. The turret containing the measure box, in rotating, brings the charge of fish opposite the empty can which has been fed into the can turret. Opposite the measure box is a plunger which now moves forward forcing the charge of fish out of the measure box and into the waiting can. Further rotation of the turret brings the can to the discharge runway leading to the salter, oiler, and seamer.

Another somewhat similar packer is the Davey machine.

Chunk Pack

In preparing the chunk-style pack, the loins have to be cut into small pieces. This is done by means of a guillotine-type cutter similar to that used for solid packs except that the cutter, instead of consisting of a single knife edge set at right angles to the length of the loins consists of knives arranged in an angular form to cut the fish into diamond-shaped pieces.

All chunk-style tuna is machine packed by more conventional type fillers such as are used in other food industries. These machines have taken over practically 100 percent of the filling of this type of pack at a great saving of cost over hand filling. The essential elements of the machine are a circular horizontal steel plate carrying the measure boxes and a series of plungers to clear the measure boxes at the proper time and tamp the material into the can.

The circular disk varies in diameter depending on the make of machine and the number of pockets or measure boxes ranged around its circumference. One popular machine has a disk approximately 36" across. This disk revolves in a horizontal plane around an upright shaft. Equally spaced around the circumference of the disk are a number of holes of a size slightly less than the can diameter. The fish to be filled into the can is received off the inspection belt from the diced tuna cutter or the flaking screen. The loose material falls on to the revolving disk and is directed into the pockets or measure boxes by a stationary plow fixed at the edge of the disk. Below each pocket is a tubular extention of such a length that its volume, when filled level with the surface, holds the material required for the in-fill weight of the can.

The lower openings of the measure boxes are closed at the time of filling by a stationary metal plate which is set close to the openings to prevent material sifting out. Beneath this plate is the empty can turret which has received the empty cans from the can chute. This turret positions the empty can directly beneath the measure box with the lip of the can close to the lower side of the plate which forms the temporary bottom of the measure box. As the turret revolves, this bottom plate opens up allowing the material to fall through into the waiting can below. At the same time, a plunger above the measure box descends and forces the material down into the can, tamping it sufficiently to form a head space in the can.

These plungers are all carried in a cage above the rotating turret, a plunger for each can. Plungers are forced down and withdrawn at the proper time by cam mounted within the cage carrying the plungers. Further revolution of the turret discharges the can. The measure box again has the bottom closed by the stationary plate, and the cycle is completed.

The Carruthers Pak-Shaper, designed for use with solid pack, can also be used for packing chunks and flakes but it is not so satisfactory as machines designed especially for this purpose and is seldom used for anything except solid packing.

Flakes or Grated Packs

Fish flakes suitable for packing as grated tuna are collected during the cleaning operation usually in large pans. They are inspected at the time of cleaning the fish and then are usually spread out in a thin layer on a moving belt where a final inspection eliminates any small pieces of skin, bone, etc. The fish then passes on to a filling machine. The same type of machine is used for flakes as for the chunk pack.

It is interesting to note that more inspection is required for the cheaper flake and grated pack than for the chunk or solid packs. In addition to employment of several sets of inspectors, some plants also utilize magnetic separators to remove any metal objects which may have accidentally dropped into the fish.

General

Packing of chunk and flake or grated packs seems to be operating at about maximum possible efficiency. Machine packing of solid pack still allows room for considerable improvement. This is a matter of engineering development, and the industry is working toward this end with maximum dispatch.

ADDITION OF OIL AND SALT

All tuna plants now use soya oil. Before the war cottonseed oil was generally used but owing to shortages of this oil, it was discontinued and various substitutes including soya oil used. Actually there is little or no difference in results when the different oils are used. Since labels have to be printed in advance indicating which oil is used and since most packers were using soya oil at the end of the war, this type has been standardized on. It is readily available at all times and at prices as low or lower than other types that might be used.

The amount of oil added to the standard No. ½ tuna can for solid pack is 1½ ounces. Some packers vary this amount a little for flake or chunk pack. The oil is generally added hot at temperatures between 160° and 225° F., each plant adjusting the temperature to what they consider to be optimum. Most plants use temperatures in the range of 180° to 200° F. and a few plants do not heat the oil at oil. Heating of the oil decreases its viscosity and increases the rate of penetration of oil into the tuna. In hand packs more uniform penetration is achieved by putting part of the oil in the bottom of the empty can and part on top after the can has been filled with fish. Such a system is infeasible when such packing equipment as the Carruthers Pak-Shaper is used owing to feeding of the empty cans to the machine on edge. Heating of the oil also helps to create vacuum in the cans where a vacumm sealer is not employed.

Oil is added to the cans of tuna along a conveyor belt leading from the packer on the packing line. Oilers are usually either of the perforated pipe or piston pump type. Quite frequently oil is added not only by separate pumps but also at different points along the line. Thus three piston pumps might add half the oil within a space of a foot or so and then the cans might travel along the conveyor for 10 feet, allowing the oil to penetrate the fish before adding the remaining oil from three additional piston pumps.. When hot oil is employed, it is heated in a thermostatically controlled tank usually employing steam pipes. The oil may flow by gravity from such an overhead tank or it may be pumped to the oilers. Excess oil which may not fall into a can is generally collected in a sump beneath the can conveyor belt, screened, and returned to the heating tank. Nozzles on piston pump oilers are sometimes provided with fine screens which prevents dripping and loss of oil between shots.

From 1/16 to 1/8 ounces of salt are added to the 307 x 113 size cans; 1/10 to 1/12 ounces of salt is an average range. Several different types of salters are employed, with two makes being most frequently employed. A few plants have improvised salters and some of these seem to work as well or better than standard manufactured salters. It was observed that a few salters spread the salt fairly uniformly over the entire top of the can. Usually, however, most of the salt was dropped in a spot about the size of a quarter in the middle of the can. Whether different degrees of uniformity of sprinkling of the salt on the can make any appreciable difference in uniformity of salt penetration into the fish is not known.

EXHAUSTING AND SEAMING

In California most of the plants employ steam boxes for exhausting followed by standard seaming machines. Time of cans in the exhaust box varies from 1 to 5 minutes with an average of 2 to 3 minutes. In a few of the plants exhaust boxes have been replaced with turret steam flow seamers. Only one plant in California employs vacuum seamers but these are used almost exclusively in the Pacific Northwest. On the Atlantic coast all three methods were used in different plants.

WASHING AND PROCESSING CANS

A wide variety of can washers were employed. These were of two types. In one type the cans passed through a confined space and were sprayed with a hot detergent or soap solution and in the other they were passed directly under a soap or detergent solution. In many instances the cans passed between rotating brushes. In all cases a final wash or spray with hot water was received.

A considerable difference in thoroughness of washing of cans was observed in the different plants. In some instances the cans were completely clean with no trace of oil film or oil droplets. In the worst instances the cans were covered with an unsightly film of oil. Such a condition will show up on the labels and, especially if a white or light colored background is employed, the label will take on a dirty tan or grey appearance. The difference in thoroughness of washing did not seem to be correlated in any way with the type of washer used. Some of the most complicated washers were observed to be doing poor jobs. It is believed that the efficiency of the washer is largely determined by the way in which it is operated. Good operation includes maintaining both water temperature and an adequate amount of soap or detergent compound in the water. Some plants had automatic equipment to add cleaning compound as needed.

In most cases some standard detergent or alkaline soap powder such as Turko, Mido, or Oakite was employed. A few plants used their own specially compounded chemical mixtures.

Processing takes place in 4 to 10 car standard horizontal retorts using basket cars. Some were of the double-ended type permitting cars to be rolled in one end and out the other. In California all retorts must be provided with recording charts and processing must conform to certain standards laid down by the State Public Health Department (see section of this report on grades and standards for canned tuna and tunalike fishes for further details). Most processors in other areas also conformed to these standards. Seventy-five minutes at 240° F. is an average processing time for the 307 x 113 size cans.

Cooling is carried out with water under air pressure. Air under pressure must be introduced with the cooling water. The air replaces the condensed steam, thus maintaining the external pressure on the cans and preventing their bursting.

LABELING, PACKING, AND STORING

Labeling, packing, and storing were quite uniform throughout the various plants. Equipment for these operations were standard labelers, casers, and sealers, either Standard Knapp or Burt in most cases. In a few plants there was a tendency to crowd the labeling and packing operations into inadequate space wherever a small bit of unoccupied area was available. This meant extra moving of packs especially where labeling or boxing took place at points remote from both retorts and storage.

Storage in practically every instance was palletized and lift trucks were employed.

PACKING METHODS IN DIFFERENT SECTIONS OF THE COUNTRY

The tuna packing industry can be divided into three areas each having its own characteristics; (1) California, (2) Oregon and Washington, and (3) the Atlantic coast.

Tuna packing had its inception in California and through the years the California packers have had ample opportunity to work out the main problems involved. Gradually machinery has been devised to take the place of many hand operations with a resulting speed-up and lowering of cost. With the abundance of raw material and ample labor supply California became the center of the industry, not only in volume of pack but in development and use of mechanical methods.

Oregon and Washington entered the tuna industry later when it was found that tuna were present off the Pacific Northwest coasts. During the period of development in California as has been previously described tuna were not generally known to exist off of the Oregon and Washington coasts and the waters were thought to be too cold for tuna to be present.

Salmon trollers venturing farther off the coast in search of salmon occasionally picked up a few tuna but did not market them. In the late 1930's and early 1940's sufficient albacore were taken for packers around Astoria and Grays Harbor to become interested in canning tuna.

The Oregon industry is centered at Astoria on the Columbia River. Here have been located large salmon canning plants and it was only natural that the canning of a new species would be first attempted by experienced canners seeking to extend their operating season. These plants, already equipped with salmon canning machinery, sought whenever possible to accommodate their existing plant to their tuna operation, installing only what specialized tuna equipment was necessary. While some of the plants became important tuna packers, the canneries were still primarily salmon plants packing tuna or salmon whichever was in season. Thus, a difference existed between California and Oregon. California plants were primarily tuna plants. Oregon plants were combination canneries.

In Oregon most of the plants are of fairly small capacity (20 - 30 tons of fish per day). One plant is of large capacity and ranks along with the major California plants in size and efficiency.

Later, in Washington, a similar development occurred whereby plants that had handled only salmon began to use the same equipment as far as possible for their new tuna operation. The Washington plants, located principally in the Grays Harbor area, are all very small plants capable of handling from 5 to 15 tons of tuna per day. Some packers have installed a complete hand-pack tuna line with precooker, guillotine, and well-built packing tables while others still use makeshift equipment, adapted from salmon canning operations.

With the gradual falling off of the tuna catch along the Oregon and Washington coasts, the plants have had to supplement their operations with imported tuna when available. These plants would like to be able to procure more imported tuna and if available would use it to extend the already shortened salmon season.

Canning of tuna on the east coast has been a new development of the last few years. Aside from sport fishing, tuna had not previously been taken commercially on the Atlantic coast. With realization that a potentially important commercial tuna fishery might be developed, small tuna packing operations have been started in Maine, Massachusetts, Maryland, and South Carolina.

All of the Atlantic coast plants have tried to incorporate tuna packing into their original fish canning operations, which may have been sardines, mackerel, or the handling of cod, haddock, alewives, etc. Existing buildings and equipment have been pressed into service for tuna as far as possible in order to hold down to the minimum the amount of capital investment required for a new and untried packing venture. Hence, usually the only specialized tuna equipment purchased has been the packing machine and guillotine. The filler may be the Pak-Shaper which is utilized for solid and chunk pack or a chunk filler may be used. Occasionally precookers and tuna racks and baskets may be purchased, but these may be outmoded equipment discarded by a west coast packer. Other plants have adapted their sardine precookers or dryers using the same racks and trays employed for sardines. In each case the effort has been to hold down the capital investment until they were sure of the supply of tuna and that the costs involved were not excessive. Existing space, often not handily located, has been utilized to house the tuna operation and extra labor is often involved in moving material about to reach odd corners in the plant. All the plants along the Atlantic coast are of relatively small tuna handling capacity ranging from 10 to 25 tons of fish per day.

Recent Changes in Preparing and Shipping Tuna to United States Canneries

Normally, only whole (round) frozen tuna are shipped for further processing to United States canneries by Japan and other foreign countries. This is the practice which has become so prevalent since the advent of the 45 percent ad valorem tariff on canned tuna in oil effective January 1, 1951. Recently, however, the Japanese have exported new forms of tuna to the United States in an effort to reduce shipping costs and to effect other savings. These new forms are frozen raw tuna loins; frozen cooked tuna loins; and frozen, canned (unsealed), precooked tuna. Each is in an experimental stage, not having taken on commercial significance up to this time.

FROZEN RAW TUNA LOINS

Sample shipments of frozen raw yellowfin tuna loins from Japan have been received in California and processed into canned tuna. Information on the quality of the canned product is not available but technologists believe that an acceptable product could be produced from the raw loins if proper freezing and packaging procedures were used.

One of the principal advantages of handling the loins instead of the whole tuna is the reduction in shipping costs. Since the "waste" portion of the whole tuna is removed in Japan there is a substantial decrease in shipping weight. Frozen raw loins also represent some savings to the tuna canneries, for the butchering operation and at least a part of the usual cleaning operation required for whole tuna is eliminated. However, the frozen raw loins must still be thawed, precooked, and partially cleaned. The raw loins received at a United States cannery were reported to contain some dark meat and skin. This product upon entry into the United States is dutiable at 1½ cents per pound.

The yield of canned tuna from frozen raw loins is reported to be approximately 73 standard cases per ton.

FROZEN COOKED TUNA LOINS

Frozen cooked tuna (albacore) loins is another recent and perhaps more promising new tuna product to be shipped to the United States for canning. The Japanese have sent limited (experimental) quantities of the cooked and cleaned loins to tuna canneries in California, where they have been processed into an acceptable canned product.

In Japan, the frozen cooked loins are prepared as follows: Whole (round) tuna are first headed and gutted (entrails removed) and then boiled for approximately 30 minutes (depending on size). After cooling, the tails and fins are removed and the skin is scraped away. Four fillets are then cut from the backbone and the dark flesh trimmed off. The cleaned fillets, or loins, are then frozen, (but not glazed) individually wrapped in parchment paper, and packed in cardboard or wooden boxes which hold about 50 pounds. Each box contains between ten and fifteen loins, depending on the size of the fish, and is double strapped prior to shipping. The recovery of cleaned loins is reported to be 30 to 40 percent.

In the United States, the imported frozen loins are first thawed by removing them from the wooden boxes and replacing in tuna baskets for approximately 24 hours. They are then removed from the baskets, unwrapped and fed into the processing machines in the same manner as with domestically cleaned fish. Since there is no cleaning of any kind necessary on the imported loins there should be no waste from this product. However, it is understood that on shipments received so far there has been approximately a 10 percent loss on the loins due to oxidation of the surface. There is also a reported shrinkage of about 5 percent, as indicated by the difference in net weight between the time the loins are packed in Japan and their arrival at the California canneries. Undoubtedly the loss due to both oxidation and shrinkage could be materially reduced by improved packaging.

Although the loins canned thus far had been subjected to cooking, freezing, thawing, and processing there was apparently no marked deterioration in quality.

In an organoleptic examination at the Service's technological laboratory in Seattle, ten persons compared the quality of canned tuna prepared from the frozen cooked loins with regular Japanese canned albacore. The results of the test indicated that there was no distinguishable difference between the two products.

A laboratory analysis of four samples of the canned tuna from frozen cooked albacore loins placed the range in protein content at 28.6 to 30.0 percent. Previously analyzed samples of canned albacore imported from Japan had a protein content of 28 - 29 percent.

There is no available information as to the quantities of frozen cooked loins which will be produced in Japan in 1953. Although approximately 225 tons of the loins have already been exported to the United States the operation is still considered to be in an experimental stage. As yet, no attempt has been made to prepare frozen cooked tuna chunks or flakes for export. Nor have species of tuna other than albacore been used. However, the Japanese are considering making experimental shipments of skipjack loins to the United States.

The factor which at present limits the commercial production of frozen cooked loins in Japan is freezer space. It is reported that there is not sufficient freezing equipment available to the Japanese fisheries to handle commercial quantities of the loins.

The preparation of the cleaned, cooked loins in Japan and their use in American canneries offers many advantages. One of these is the reduction in shipping costs. Since only the usable portion of the tuna is shipped, freight charges normally paid on the "waste" parts of tuna are saved. Cooked loins are in a more favorable position in this regard than the raw loins referred to above since the loins lose an appreciable amount of weight during the precooking and cooling operations.

In the United States the most significant feature of the imported frozen, cooked and cleaned loins is the savings in personnel. When imported cleaned loins are used, few, if any, of the women normally employed in the cleaning operation are required. The butchering and precooking operations are also eliminated.

Whether or not this new type operation will be profitable to American canneries depends entirely on the price at which the Japanese will sell the cooked and cleaned loins. The rate of duty for entry of these product as imports into the United States is 1 cent a pound, net weight, if "in bulk or in immediate containers, weighing with their contents more than 15 pounds each", and 12½ percent ad valorem if "in immediate containers weighing with their contents not more than 15 pounds each".

FROZEN, CANNED (UNSEALED), PRECOOKED TUNA

Another new product designed to avoid a great part of the tariff charges assessed against canned tuna exported to the United States is frozen, canned (unsealed), precooked tuna. Reduction in labor costs to United States canners is also involved. The new product is similar to frozen raw loins and frozen cooked loins in that it involves a split plant operation; part of the canning operation being carried out in Japan and part in the United States.

A few sample cases of the frozen, precooked tuna, hand packed in open No. ½ tuna cans have been shipped from Japan to a tuna cannery in the United States. Each case contained 48 cans of solid pack albacore.

Full information on the method of packing the tuna in Japan is not available. However, it is assumed that the usual butchering, precooking, cleaning, and packing procedures are used, with the exception that oil and salt are not added to the cans of tuna. Following packing, the open cans of tuna are frozen. Cases of the frozen, canned, (unsealed) precooked tuna are then shipped by refrigerated vessels to the United States.

At the cannery in the United States the only steps required to convert the frozen canned (unsealed) product into the conventional hermetically sealed canned tuna are thawing, addition of oil and salt, sealing, processing, labeling and repacking in cartons. Since nearly all of these operations are mechanized, only a very small percentage of the labor normally required by United States canners for tuna canning is needed.

It is reported that the sample lot of canned albacore packed from the frozen, canned (unsealed) precooked product compared favorably in quality with canned tuna packed from imported frozen raw Japanese albacore.

There are indications that this product when entered as an import into the United States is dutiable at a rate of 12½ percent ad valorem.

If commercial scale tests prove that the operation is feasible it could have a drastic effect on the domestic tuna canning industry. Practically all of the plant labor now employed in tuna canning operations up to the point of adding oil and salt to cans of tuna meat could be eliminated. Furthermore, neither the skilled labor nor the specialized equipment which is required in a modern tuna canning plant would be needed. It is conceivable that any food cannery could receive the frozen, canned, (unsealed) precooked tuna from Japan and complete the canning operation with its present equipment and labor.

It is possible that this entire method of producing canned tuna may be covered by United States patent 2,110,801, Method of Canning Tuna, Clams, and Oysters, dated March 8, 1938.

BYPRODUCTS OF TUNA CANNING

At least 50 percent of the weight of the whole tuna, as landed, is not canned. However, all of the so-called "waste" material is not a direct loss to the plants, for much of it is used to produce byproducts of some value, such as liver oils, solubles, liquid fertilizer, tuna oil and meal.

Liver Oil

During the dressing or butchering operation the thawed tuna are slit and the viscera removed. In some plants, which manufacture liver oil, the operation is carried one step further by separating the livers from the viscera. The livers are then processed to extract the oil.

Tuna liver oil, once a valuable byproduct because of its high vitamin D content, has declined in both value and production during recent years. Synthetic vitamins and increased imports of natural vitamin oil have caused the decline.

Solubles and Liquid Fertilizer

In many of the tuna canning plants all of the visceral material, including the livers, is collected for use in the production of fish solubles and liquid fish fertilizers. In producing liquid fish fertilizer one patented process utilizes the naturally occurring enzymes of the entrails to liquify the protein components.

Meal and Oil

The fins, head, skin, bones and other parts of the precooked tuna which are not suitable for use in the solid, chunk, or flake packs are separated from the edible tuna meat during the cleaning operation. This offal is then conveyed to the reduction plant where it is cooked with live steam under pressure and then pressed to expel most of the oil and some of the water. The oil is then separated from the water for marketing as "tuna oil". The water phase (press liquor) containing dissolved protein, water soluble vitamins and minerals, is concentrated in vacuum evaporators to produce fish solubles. The pressed fish material, or presscake, is dried in mechanical dryers to produce fish meal having a moisture content of approximately 8 percent. Tuna meal has a slightly lower protein content than meals prepared from whole fish, such as menhaden, herring and pilchards. However, it is readily accepted for use as an important ingredient of many animal feeds.

Efficiency of Use of Offal

None of the "waste" material from tuna canning operations is discarded.

Because the head, skin, bones, and other parts removed during the cleaning operation have been cooked (precooking operation) it is not likely that more efficient use can be made of this material than conversion into meal and oil. On the other hand, the viscera, which are removed from the tuna prior to cooking, may be a source of products which are more valuable than those now produced from this material. It is generally accepted that fish viscera represents a potential source of valuable pharmaceutical preparations and other chemical compounds. Some of these products have been prepared from tuna entrails in the laboratory and on a semi-commercial scale. However, much more investigational work will be required before such products can be profitably produced on an extensive commercial scale.

The tuna canning industry utilizes its "waste" material as efficiently as any other segment of the domestic fishing industry.

DISCUSSIONS OF EFFICIENCY IN TUNA CANNERIES

In the average tuna cannery up to 70 percent of plant production cost is the cost of the fish and 10 percent to 12 percent is shore labor. At $13.00 per case total labor amounts to only $1.30 to $1.56 per case. Thus only some very drastic improvement which would eliminate a large part of the existing shore labor could make any really substantial reduction in the cost of canned tuna. The only major item of labor which might be reduced is that involved in the cleaning operation. Present cleaning costs approximate $.50 per case. Even if a completely automatic process for cleaning could be developed and this labor eliminated, a portion of the saving would undoubtedly have to be paid as royalty for use of the elaborate machinery developed. It is also possible that a mechanical cleaning machine would give a lower yield of cleaned loins than at present is obtained from hand cleaning. Both of these things occurred when hand-packing was replaced by machine-packing. Labor saved in all other steps of the canning operation combined, even if feasible, could not amount to more than a very few cents per case.

Potentially, more money could be saved by increasing the yield of the canned product. Of the various stages where yield increases are possible, the precooking stage is the one where greatest savings might be made. Such savings could be accomplished in some plants by more uniform cooking of the fish. By sorting fish into more size groups each batch would have a smaller range of sizes so that in giving the largest fish in the batch the optimum cook, it would not be necessary to so greatly overcook smaller fish. It might even be worthwhile to reduce the size of precookers in some of the canneries and use more of them. This would facilitate the division of fish into larger numbers of size groups.

Another possible saving in loss of fish during precooking is to reduce the length of the precook. The precooking stage accomplishes a number of objectives. The most important of these is making the fish easier to clean. Long experience in the canneries has shown that unless the fish is given a certain minimum precooking time, rate of cleaning falls off and the yield of well-cleaned loins is reduced. If present efforts to develop a mechanical cleaning machine are successful, and if such equipment works equally well on raw or undercooked fish as on fully precooked tuna, this advantage of the precook will be eliminated.

A second result of the precook process is elimination of much of the natural tuna oil which is cooked out and discarded. There is some belief that this tuna oil has a strong, disagreeable flavor. This is true if the fish have been held in cold storage for extended periods of time, stored at too high storage temperatures or have not been adequately protected against access to air. Under such storage conditions, the tuna oil becomes oxidized, resulting in a rancid flavor, and its elimination during precooking is necessary if a first-class product is to be produced. Ordinarily, if fresh or properly stored tuna are used, a good product without off flavor will result even if the tuna oil is not removed. With some of the darker species of tuna, the tuna oil may, even when fresh, have a distinctive flavor which makes its removal preferable.

A third result of the precook process is elimination of water together with some dissolved tissue components. Thus, the precooked tuna has a lower moisture content and a higher protein content than the raw fish. Precooking alters the texture of the tuna; the longer the precook the greater the texture difference. After the fish has been retorted in the cans, however, any texture difference due to precooking is partially eliminated. The retorting process, being carried out at a much higher temperature than the precook, is much more drastic even though the processing time is much less. Normally precooked fish give up very little oil or moisture while being retorted in the can. Raw or under-precooked fish, on the other hand, liberate some of the juices which would have been cooked out in a thorough precook and, instead of being discarded, they are retained in the can.

Moderate reduction of the precook time has the following results on the final retorted product in the can:

1. Less of the flavorful juices are discarded (in the precook) and are present to flavor the fish in the can. This is an advantage to the consumer if fresh, properly stored tuna are used, because the flavors lost in the precook are natural flavors which add to the desirable flavor of the product. On the other hand, this loss would be an advantage to the consumer in case the fish were not fresh or had been held frozen for too long a time or under improper storage conditions. Under such circumstances the loss of flavors would be a loss of undesirable constituents which would have altered the flavor of the tuna in a deleterious way.

2. The protein content is less and the moisture content is greater. This is a disadvantage to the consumer because he is getting less protein for his money. It is an advantage to the producer because he will increase his yield of canned tuna per ton of raw fish.

3. Cans of undercooked tuna contain a greater volume of aqueous liquid phase containing dissolved protein which might not be noticed by the consumer because it lies beneath the added vegetable oil. It would probably be discarded by the consumer if he poured off the vegetable oil (this is the usual practice) and would be lost for all practical purposes.

The possibility of reducing the length of precook, especially if mechanical equipment is developed to clean the fish, is one that will undoubtedly receive considerable attention from the industry in the future. Already a number of producers are experimenting along these lines. If the precook is not cut too drastically, a superior product of better flavor might be obtained which would offset any disadvantage to the consumer due to lowered protein content. If carried out to such an extreme that raw or nearly raw fish were being canned, the disadvantages of reduced protein content and excess retort juices in the can would probably more than offset any advantages to the consumer. Furthermore, raw tuna cannot at present be retorted without the development of unsightly curd on the surface. Unless this difficulty can be overcome by some technological development, it is unlikely that any processor will go to the extreme of retorting raw tuna.

The final attitude of the Food and Drug Administration to any reduction in precooking time for tuna is unknown. The original tentative standards proposed by this agency made no provisions for regulation of precook time and tuna retorted without any precook would have complied with such tentative standards which measured only the amount of fish placed in the can regardless of how or whether it had been precooked. At the present time, the Food and Drug Administration is giving consideration to adopting some standard which would at least restrict any reduction of precooking time. This would be accomplished by requiring a minimum solids content per can as determined by a proposed "press weight" procedure.

Some reduction in precook time has already been adopted by much of the industry. Any future changes adopted in precooking time in an effort to save on yield of the fish and possibly to improve flavor must be balanced against any adverse changes in appearance and texture of the product.

Another point in the processing of tuna where an increase in yield might be obtained is in the machine packing of the solid-style pack. A Significant loss of fish may be taking place during packing by the machines now used by a large part of the industry. Efforts are already underway to eliminate or reduce these losses. To this end, two new machines are being tried and a modification of the machine now being used will be available shortly.

In conclusion, it is not believed that any appreciable increase in efficiency of the industry can be accomplished without drastic alteration in the entire process of tuna canning. As with any industry, a few isolated plants are using obsolete or inefficient methods, but the industry as a whole is operating in a manner which allows it to utilize all the latest advances. Furthermore, it is looking ahead to the time when improvements in processing equipment will be available and is carrying out research in an effort to develop new processes and equipment, especially with regard to the precooking and cleaning style.

QUALITY OF CERTAIN PACKS OF TUNA

The following factors are considered in the work on quality of certain packs of tuna:

1. Effect of duration of precook time on the quality of the pack.
2. Effect of method of packing on the quality of the pack.
3. Effect of packing medium (oil or brine) on the quality of the pack.
4. Comparison of the quality of Japanese and American canned tuna.

Samples of canned tuna for examination were, in some cases, procured at retail, in other cases directly from the tuna plants or were put up experimentally either at a commercial tuna cannery or at the laboratory. Quality of the packs was determined organoleptically and by making physical and chemical laboratory tests.

Effect of Duration of Precook Time on the Quality of the Tuna Pack

A very brief experiment was carried out to obtain firsthand knowledge as to the effects of varying precook time on the quality of tuna on the quality of tuna canned therefrom. During the field survey of the industry, many comments had been made by processors regarding the importance of this stage of the processing in obtaining the maximum yield. Opinions varied as to the effect on the quality of the pack of shortening the precook.

Albacore, caught about August 1, 1952, in waters off the coast of Oregon and held since that date in cold storage at 0° F., were used for this experiment carried out on November 17, 1952. Eight fish ranging from 11.5 to 15.5 pounds and averaging 13.3 pounds were thawed and butchered. Three fish were precooked for what was estimated to be normal precooking time (2½ hours at 218° F.), three were cooked for one-half of the normal time (1¼ hours at 218° F.), and two fish were not cooked at all. All three batches were then cleaned, packed with oil, and processed in the usual way. Fish were sampled at various stages, weighed, and protein, moisture, and oil content were determined.

Butchering losses amounted to only 2.8 percent. The loss of weight brought about by precooking (before cooling) amounted to 14.4 percent (based on the total weight of the fish) for the half normally cooked fish and 16.1 percent after normal precooking period. The total losses (occurring during cooking and cooling) were 17.3 percent and 19.9 percent respectively.

In tables 74, 75, and 76 are shown the protein, moisture, and oil content of the fish. Analyses are shown for the precooked fish before addition of oil or salt and for the final canned fish after draining away the oil. Each figure in these tables represents an average of values from six Number ½ tuna cans. In table 77 is shown the amount of fluids (aqueous phase and oil) drained from a No. ½ tuna can receiving different degrees of precook and the amount of dissolved solids in the aqueous phase of such fluids. Here again values reported are averages of data obtained from six cans of fish.

The protein content of drained tuna, determined before retorting, rose from 22.4 percent for uncooked fish to 28.1 percent for fish given the full precook time (table 74). This difference is not nearly so great after the fish had been retorted, an increase of from 26.1 percent (no precook) to 27.5 percent (normal precook) occurring for the same samples. The final retorting, being a much more drastic process than the precook, tends to equalize differences due to the degree of precook.

TABLE 74.- PROTEIN CONTEND OF ALBACORE, PRECOOKED TO DIFFERENT EXTENTS, BEFORE AND AFTER FINAL RETORTING

PRECOOK TIME	PROTEIN CONTENT BEFORE RETORTING 1/	AFTER RETORTING 2/
	PERCENT	PERCENT
NONE	22.4	26.1
ONE-HALF NORMAL-1 1/4 HRS. @ 218°F.	26.4	27.6
NORMAL - 2 1/2 HRS. @ 218°F.	28.1	27.5

1/ ANALYSES WERE CARRIED OUT ON THE TUNA BEFORE ADDITION OF OIL AND SALT.
2/ ANALYSES WERE CARRIED OUT ON DRAINED SOLIDS.

TABLE 75.- OIL CONTENT OF ALBACORE, PRECOOKED TO DIFFERENT EXTENTS, BEFORE AND AFTER FINAL RETORTING

PRECOOK TIME	OIL CONTENT BEFORE RETORTING 1/	AFTER RETORTING 2/
	PERCENT	PERCENT
NONE	13.5	15.0
ONE-HALF NORMAL - 1 1/4 HRS. @ 218°F.	11.5	16.3
NORMAL - 2 1/2 HRS @ 218°F.	14.2	19.5

1/ ANALYSES WERE CARRIED OUT ON THE TUNA BEFORE ADDITION OF OIL AND SALT.
2/ ANALYSES WERE CARRIED OUT ON ON DRAINED SOLIDS.

TABLE 76.- MOISTURE CONTENT OF ALBACORE, PRECOOKED TO DIFFERENT EXTENTS, BEFORE AND AFTER FINAL RETORTING

PRECOOK TIME	MOISTURE CONTENT BEFORE RETORTING 1/	AFTER RETORTING 2/
	PERCENT	PERCENT
NONE	64.6	57.0
ONE-HALF NORMAL - 1 1/4 HRS. @ 218°F.	61.5	55.9
NORMAL - 2 1/2 HRS @ 218°F.	58.5	52.4

1/ ANALYSES WERE CARRIED OUT ON THE TUNA BEFORE ADDITION OF OIL AND SALT.
2/ ANALYSES WERE CARRIED OUT ON DRAINED SOLIDS.

TABLE 77.- QUANTITY OF LIQUIDS AND DISSOLVED SOLIDS FROM RETORTED CANS OF ALBACORE WHICH HAD BEEN PRECOOKED TO DIFFERENT EXTENTS

PRECOOK TIME	AMT. OF AQUEOUS FLUID PER 1/2 - LB. CAN	AMT. OF OIL PER 1/2-LB. CAN	DISSOLVED SOLIDS IN AQUEOUS FLUID
	ML	ML	PERCENT
NONE	22	32 1/2	11.9
ONE-HALF NORMAL 1 1/4 HRS. @ 218°F.	10 1/2	28	17.0
NORMAL 2 1/2 HRS. @ 218°F.	3-2/3	26-1/3	18.1

The variation of the oil content of the tuna with differing degrees of precooking before addition of vegetable oil and before retorting (middle column, table 75) is probably meaningless because each of the three precook groups consisted of different individual fish of different initial oil content. The data in the last column of table 75, showing the oil content after retorting with added vegetable oil, are of more significance because in this case there was an excess of free oil present which tended to bring the oil content of the fish to an equilibrium state regardless of the initial oil content. The canned fish which received no precook had an oil content of 15 percent as compared to 19.5 percent for fish receiving the full precook. Thus it appears that absorption of added vegetable oil takes place to a greater extent, the longer the fish is precooked before addition of oil.

The moisture content of tuna, both before and after final retorting, showed a decrease as the length of precooking time increased (table 76). This moisture content decrease amounted to about 6 percent regardless of whether it was measured before or after final retorting.

The degree of precook had a very pronounced effect on the amount of aqueous fluid formed during retorting (table 77). Thus, in fish which received the normal precooking time, the canned product contained only 3 2/3 ml. of aqueous fluid as compared to 22 ml. where uncooked fish was retorted or 10½ ml. where the fish received only one-half the normal precook time. The percentage of dissolved solids in the aqueous phase (table 77) decreased with decreasing precook time, but the total quantity of such solids increased as the precook time decreased. The decrease in the amount of free oil in samples receiving a longer precook time is probably due, at least in part, to a greater absorption of oil by the flesh of such fish (see table 75).

The appearance and texture of the three packs differed considerably. The most striking difference was the occurrence of much white curd on the surface of the fish which had not been precooked. None of the samples receiving one-half or full normal precooking time had any trace of curd. The samples from fish receiving no precook were also of a very different texture which kept the fish from flaking at all readily. A sample in the can appeared as if it were one solid chunk of fish (welded together at the surface by the curd), and it could be broken apart only with considerable difficulty. Even aside from the presence of the curd, this texture difference was one which would sharply differentiate the fish from what one normally associates with tuna. This altered texture apparently acted as the main barrier to penetration of the vegetable oil into the flesh.

Thus, although the tuna processed without precooking contains more natural tuna oil, the total amount of oil (after absorption of vegetable oil during retorting) (table 75) is less. Thus the amount of vegetable oil absorbed in the tuna from fish which has not been precooked must be a great deal less than that in the normal pack.

Although the tuna retorted without precooking contained six times as much aqueous liquid as the normal pack, this fact is not readily apparent when a can is opened. There is always a sufficient excess of oil floating at the surface of such cans so that the aqueous layer, near the bottom of the can, would not ordinarily be noticed.

A series of penetrometer readings were made on the experimental samples prepared from tuna precooked to different extents (table 78). The greater the length of precook, the more tender was the texture of the fish. The differences (9.96 for no precook, 10.48 for one-half of normal cook, and 10.92 for normal cook), although not numerically large, represent a definite difference which is easily detectable organoleptically.

Effect of Packing Methods on the Quality of Solid Packed Tuna

Before the introduction of machine packing, solid-pack tuna was put up very carefully by hand. A good hand-pack contained three pieces of fish tightly filled into the can without any voids between pieces. The action of the guillotine prior to filling cut the loins cleanly giving a very smooth-cut surface. When these hand-packed cans were retorted, some shrinkage took place, but the tightness of fill before retorting was sufficient to prevent development of any appreciable spaces between pieces. When such a retorted can was opened, the appearance was almost as if one piece of fish had been filled into the can, with only faint lines showing between pieces.

Machine packing has caused several alterations in the appearance of the canned product which may be considered by experts to be adverse changes. (These alternations apparently have not effected the price of the machine-packed product nor its consumer acceptance.) These changes involve (1) presence of spaces between pieces in the machine-packed fish, (2) presence in some cases of a large number of pieces in a can, (3) distortion of the fibers of the cut loins, causing some flaking, and (4) adsorption of oil caused by (1), (2), and (3) above.

TABLE 78.- PENETROMETER READINGS ON PROCESSED CANNED TUNA GIVEN DIFFERING LENGTHS OF PRECOOKING

Note: Increasing penetrometer readings denote increase in tenderness.

EXTENT OF PRECOOK	CAN NUMBER	PENETROMETER READINGS				
		1	2	3	4	AV.
		MM.	MM.	MM.	MM.	MM.
NONE	1	9.0	8.5	7.5	9.5	8.6
	2	12.0	10.0	10.5	11.0	10.9
	3	10.0	10.0	9.5	9.0	9.6
	4	9.5	9.0	9.5	10.0	9.5
	5	11.5	11.0	9.5	9.0	10.2
	6	12.5	11.5	9.0	9.0	10.5
	7	10.0	9.5	9.5	10.5	9.9
	8	11.5	11.5	10.0	11.0	11.0
	9	10.0	9.0	8.5	10.0	9.4
		OVERALL AVERAGE				10.0
ONE HALF NORMAL	1	10.5	10.0	11.0	12.0	10.9
	2	10.0	11.5	11.5	10.5	10.9
	3	10.5	10.0	12.5	10.5	10.9
	4	10.0	10.0	9.0	10.0	9.8
	5	11.0	12.0	9.5	9.0	10.4
	6	11.0	10.5	11.0	12.0	11.1
	7	10.5	10.0	10.0	9.5	10.0
	8	11.0	9.5	11.0	11.5	10.8
	9	9.5	8.5	10.0	10.0	9.5
		OVERALL AVERAGE				10.5
NORMAL	1	12.5	11.5	14.0	16.0	13.5
	2	9.0	8.0	9.0	8.0	8.5
	3	10.0	9.5	8.5	9.0	9.2
	4	10.0	8.5	9.5	9.5	9.4
	5	12.5	12.0	10.0	11.5	11.5
	6	11.0	9.0	10.0	10.5	10.2
	7	13.0	12.5	13.5	15.0	13.5
	8	14.5	11.0	10.5	12.0	12.0
	9	11.0	11.5	9.5	10.0	10.5
		OVERALL AVERAGE				10.9

Points (1) and (2) above occur as a result of imperfect staggering of the loins of tuna as they enter the filling machine. This staggering is carried out by hand and requires considerable skill. Greater uniformity in this operation can be attained both by using more skillful operators and by increasing the number of workers feeding a machine. Most plants use only one such feeder, but where two or even three such workers are utilized, the resulting fill is much improved. When very small fish such as skipjack are being canned, differences due to skill of feeding the machine are especially critical. Even by using the most skilled workers and employing several of them for each Pak-Shaper, it is difficult to avoid some imperfect overlapping, with resulting voids between pieces in many of the cans.

A second type of change is brought about during kneeding of the tuna loins within the forming tunnel of the Pak-Shaper. During this operation, the loins are subjected to a twisting stress which distorts the fibers. This results in some separation of the flakes.

Another effect which may result from the machine packing of tuna arises from greater absorption of oil by the fish. The distortion of the muscle fibers in the Pak-Shaper results in the flesh having an increased capacity to absorb oil. In such cases, unless a large quantity of vegetable oil is added, the possibility exists that the surface of the fish may not be covered by oil during retorting. This may contribute to surface discoloration or so-called scorching.

Apparently, there is a considerable variation in the amount of distortion of the tuna fibers in the Pak-Shaper such as to make for somewhat variable amounts of absorption of oil. Thus, if the same minimum amount of oil is added to all cans, some will have insufficient free oil to cover the surface of the fish. A few packers overcome this difficulty by adding an excess of oil. This practice, however, may result in leaving inadequate headspace in some of the cans.

Comparison of the Quality of Oil and Brine Packs

The principal difference between the oil and brine pack is the oil content of the drained tuna. Use of brine in place of oil as a packing medium results in a product containing no oil other than the natural tuna oil left in the flesh after precooking. The precooking process removes a part of this natural oil. Since the oil content of tuna varies widely both from species to species, and from fish to fish, the amount of oil left in the flesh after precooking also varies widely.

Individual cans of experimental brine pack tuna had oil contents varying all the way from 1.7 to 13.5 percent, a difference of eight times. Packing the tuna in oil resulted in the absorption of considerable vegetable oil into the flesh. Thus of the oil pack samples examined, oil content of the flesh varied from 9.2 to 20.2 percent.

Those samples of brine pack tuna having very low oil content differed from the ordinary oil pack to a very marked extent and when examined by tasting panels could be readily distinguished. For example, a low oil content brine pack and a normal oil pack of tuna were made into two casserole dishes with spaghetti. A taste panel examined these two dishes without knowing their identity. All eleven members of the panel individually picked out the oil pack as being preferred, even though the tuna was greatly diluted by the presence of the spaghetti. While the difference was not pronounced, it was completely distinguishable. From an organoleptic standpoint, the difference between oil and brine packs seems to be a matter of a greater oily texture of the oil pack. This texture difference is not so much a matter of tenderness or toughness of the flesh as it is of a difference in the feel of high and low oil content flakes of fish when held on the tongue. When the texture of oil and brine packs are measured with a penetrometer, the oil packs are only slightly more tender than the brine packs. Brine packs had an average penetrometer reading of 10.6 as compared to 11.8 for oil packs. This relatively small difference in no way accounts for the very definite difference noted organoleptically.

A rumor to the effect that brine packs of tuna toughen upon prolonged storage was investigated. Preliminary findings (more prolonged storage tests are still underway) indicate that both brine and oil packs show an increase in toughness in the first few weeks after they are canned. Thus immediately after being canned, brine packs of tuna had an average tenderometer reading of 16.4 and oil packs prepared from adjacent sections of the same loins had a reading of 15.9. Six weeks after the tests began, the readings had decreased to 13.4 and 13.2 respectively. Tests on other tuna, which had been put up for a period of many months, showed average readings of 10.6 for brine packs and 11.8 for oil packs. There was no significant difference in the readings for tuna held for six months as compared to readings on samples held for one or two years. Apparently increasing toughness is a change which takes place during the first few months of storage, and probably the texture has already reached its maximum toughness by the time the pack reaches the consumer.

Comparison of the Quality of Japanese and American Canned Tuna

Japanese cannery costs for labor and for purchase of tuna are lower than is the case in the United States. This has resulted in certain differences in cannery methods which have a bearing on the quality of the canned tuna. Since the cost of fish is of less importance to Japanese than to American processors, the Japanese processors are probably not so careful to keep the precooking time to a minimum as are the American processors. As a result most Japanese tuna apparently is precooked longer than is American tuna, and in fact, much of the Japanese tuna seems to be given what in this country would be considered an overcook.

The tuna canning process employed in Japan yields a product having a higher protein content than the American product due to the longer precook mentioned above. The protein content of the Japanese pack rarely falls below 28 percent whereas that of the American pack lies between 25 and 28 percent.

The oil content of all samples of Japanese-packed tuna examined was relatively low. In the oil-packed samples of albacore the oil content of the drained fish ranged from 3.2 to 7.0 percent. Japanese brine packs were of even lower oil content (often as low as 2 percent or less) because the natural oil present in such fish is not supplemented by any added vegetable oil. Owing to the higher protein and lower oil content, the Japanese tuna has a somewhat more solid texture than the American pack.

The flavor of imported tuna is usually more flat and tasteless than that of the American fish. Possibly this is due to a longer precook having volatilized a portion of the natural flavoring components in the imported canned fish. Also, some foreign packers tend to use less salt than is common with American tuna canners, and this may account for a part of the difference. Another explanation is that a number of American tuna canners use monosodium glutamate which brings out the flavor of the tuna. Still another explanation and one which has been advanced by some members of the American tuna industry is that the imported fish may have been stored in the frozen state for long periods of time which may lead to a loss of flavor.

No comparisons of domestic and foreign oil packs of canned tuna were made in this work. Sales of foreign tuna canned in oil in the domestic market are at a minimum since January 1, 1951, the inception date of the present 45 percent ad valorem duty on those products. From a practical standpoint foreign packs of tuna canned in oil are presently not an important factor in the American market.

GRADES AND STANDARDS FOR CANNED TUNA AND TUNALIKE FISHES

The immediately previous sections have detailed various tests of quality of certain packs of canned tuna. These were in the nature of consumer quality tests of the end product of processing. Long before the canned products of the tuna industry are used by consumers there are many regulations and standards of State and Federal government to which the industry must adhere. In addition the industry has its own voluntary quality control methods. These regulations, standards and quality control methods are given in detail in the following three sub-sections.

Regulations and Standards of State Governments

Legal standards, grades, and other requirements for processing canned tuna are set up and enforced by both State and Federal agencies. In most states such requirements are very nominal or even non-existent. In California, however, where most of the tuna is processed, there are very extensive requirements and rigid enforcement which came into effect approximately thirty years ago. An authority was set up in the California Department of Public Health to supervise operation of all canneries within the State insofar as maintenance of adequate standards of quality of raw material, sanitation in the plants, and proper sterilization of the product is concerned. Enforcement of regulations is carried out by supervisors and inspectors of the Department of Public Health. The Department maintains such regulation over the entire fish canning industry, as well as over the canning of fruit and vegetable products. It also operates a research and testing laboratory under the general supervision of a member of Hooper Medical Foundation of the University of California.

California State sanitation requirements begin with the fishing vessel which must obtain a sanitary certificate showing that the vessel has been cleaned in a satisfactory manner. The regulation with respect to such cleaning is as follows:

"The cleaning operation of all holds, bait wells, bait tanks and decks must be carried out under the supervision of a duly authorized representative of the California State Department of Public Health.

"The cleaning operation shall be carried out by scrubbing or steam cleaning the surfaces of all holds, bait wells, bait tanks and decks where fish intended to be used for canning purposes are stored, after which a thorough rinsing is to be given and then the surfaces are to be treated with a chlorine compound.

"The brine cooling coils on all brine tuna boats shall be cleaned with either a chlorine solution or solution of chloride of lime, which is to be carried out by pumping the solutions through the coils. A thorough rinse with clean, fresh water should follow the application of the above-mentioned solutions.

"Where boats are fishing in local waters only, a certificate good for 30 days will be issued, after which the boat will have to be thoroughly cleaned again. If in less than 30 days sanitary conditions are found to be unsatisfactory, the boat will be ordered to clean up before being allowed to deliver fish to any commercial cannery.

"For boats that are fishing in foreign waters, the cleaning operation must be done before their departure on each trip, and the certificate surrendered at the end of each trip before being allowed to unload their cargo."

The California State Public Health Department also inspects tuna for decomposition in accordance with its Regulations and Specifications Governing the Delivery, Handling, and Inspection of Tuna, Mackerel, and Sardines which reads as follows:

"GENERAL RULES

"1. The term 'decomposed' as used herein shall be taken to mean fish that are 'in whole or in part diseased, contaminated, filthy, putrid or decomposed or otherwise unfit for food'. (California Pure Foods and Drugs Act, 1939, approved July 13, 1939.

"2. The Bureau of Cannery Inspection of the State of California and its inspectors shall require the seller of raw fish and the canning organization involved in each sale to comply with the provisions of the California Pure Foods and Drugs Act, 1939, prohibiting the manufacture, production, preparation, compounding, packing, selling, offering for sale or keeping for sale any decomposed fish. The responsibility for maintaining an effective inspection service and of eliminating decomposed fish from the canned product shall rest upon the Bureau of Cannery Inspection of the State of California and the executive head of each canning organization.

"3. The inspector in charge at the plant shall require that all cannery operations be carried on under clean and sanitary conditions and require the immediate disposal of decomposed fish, fish offal and bait chum.

"4. These regulations may be amended at any time as provided by law.

"STANDARDS

"1. Inspection of raw fish shall be strict and uniform and shall be designed and carried out to the end that fish unsuitable for canning shall be rejected in the raw state insofar as possible.

"2. The standards to be used in the examination and judging of fish shall be such as will make the resultant product conform to the Food, Drug and Cosmetic Act of the United States and to the California Pure Foods and Drugs Act, 1939, approved July 13, 1939.

"3. The Bureau of Cannery Inspection shall reject fish only if decomposed or unfit for canning for human consumption. The Bureau will not reject cooked fish because of its color or quality, unless such color or quality indicates decomposition as defined in section 1 under General Rules.

"4. Split, mashed or broken fish shall be condemned if deemed by the inspector to be necessary for the prevention of acceptance of decomposed fish.

"5. The canner shall, promptly on arrival of each boat-load of fish, notify the Bureau of Cannery Inspection, and no canner shall receive fish into its plant until authorization is given by the inspector.

"6. Raw tuna shall be inspected by the Examination of each raw, defrosted fish at the time they are eviscerated. 'Defrosted' shall mean that each fish is thawed out to bhe point that odors are readily detectable. Cooked fish shall be inspected at such places and times as may be directed by the inspector to insure compliance with the law and these regulations.

"INSPECTION SERVICE

"1. The inspection of all fish for canning purposes shall be under the direction of the Chief of the Bureau of Cannery Inspection of the State Department of Public Health. The inspector on duty at each plant shall observe that all operations are carried out in a sanitary manner and in a manner to prevent the canning of decomposed fish, and shall immediately report to his superior officer any unusual or objectionable practice.

"2. In order to facilitate and expedite the administration and enforcement of the aforementioned Acts and these rules, each canner may select sufficient personnel from his own employees who shall be trained by an inspector of the Bureau to examine fish. The supervising inspector shall notify each canner in writing the names of employees of each company who are approved by the Bureau as fish examiners. This approval shall be valid only for a period of three months and only for the plant or plants specified in the approval.

"3. The detailed examination of the fish shall be made by an inspector or an approved cannery fish examiner under the supervision of an inspector. The inspector shall specify the number of cannery fish examiners required, in accordance with the condition of fish in process from time to time, and the canner immediately shall supply the number so specified, referring any difference of opinion in this regard to the inspector in charge of the district. The approved cannery fish examiners shall at all times be under the direction of the inspector in charge at the plant while they are performing the duty of examining fish. The inspector in charge at the plant may call upon the cannery management for an approved substitute whenever any authorized cannery fish examiner is, in the opinion of the inspector, doing his work unsatisfactorily. In the event such substitution is not immediately made, an inspector shall be assigned to replace him until an approved substitute is available. The canner involved shall not receive or pack any fish until a proper substitute or an inspector is available. All costs shall be assessed against the canner involved.

"4. The inspector in charge of the district shall have full authority over the activities of his subordinates while assigned to the respective canneries.

"REPORTS

"1. The inspector shall make a written record of each boat load on a printed form. The records shall state total quantity of fish and include such evidence as the inspector may be able to obtain as to the method of handling.

"2. The Bureau shall have free access to the records of each cannery which bear directly on the problem of fish and cannery inspection.

"3. Condemned fish shall be weighed by the canner in the presence of the inspector and the inspector's report shall show accurately the weight of condemned fish. The inspector shall keep separate weight records of fish rejected by the canner because of quality or condition other than decomposition.

"FISHING VESSELS

"1. Decks and holds of all boats and vessels catching tuna, mackerel or sardines and transporting them to a cannery shall be kept in a clean and sanitary condition. The requirement for cleaning vessels and boats shall be enforced regardless of the size or type of the vessel or boat and shall be uniform throughout the State.

"2. Each vessel shall keep a written log which shall be available to the inspection service. Records of net boats shall show the time of each set.

"3. No decomposed chum may be used for bait or in taking mackerel. All bait or chum used must be fresh (not over 24 hours old) unless it be salted or frozen.

"4. High seas fishing boats, whether net or bait, shall keep a record of their catch and their methods of handling fish, including hold and water temperature, upon forms provided by the Chief of the Bureau of Cannery Inspection.

"5. The Chief of the Bureau of Cannery Inspection or his authorized agent may require interested parties, including members of the laboratory staff, to appear before him when undue quantities of fish have been condemned. He shall make inquiry of the fishermen to determine the methods used in fishing and handling and shall endeavor to explain to the fishermen the proper method of handling raw fish to prevent the recurrence of the loss. Representatives of the United States Food and Drug Administration of the Federal Security Agency and other interested parties may be admitted to the inquiry.

"DISPOSAL OF CONDEMNED FISH

"1. When a boat-load of tuna or mackerel has been condemned as unfit for canning, the inspector shall notify the supervising inspector who shall take such action as is necessary to prevent delivery of the rejected fish to any other plant.

"2. When a boat-load of sardines has been condemned and the canner to whom delivery was offered cannot receive the fish for reduction purposes, the inspector shall take the necessary steps to prevent the canning of these fish by any other canner.

"3. In all cases the inspector shall serve notice upon the captain of the boat whose fish are condemned that they shall not be used or sold for canning purposes.

"4. The inspector shall take such action as may be necessary to insure that fish which are condemned for canning purposes shall not be used for canning.

"SAMPLING

"1. The inspector in charge of the district shall determine whether or not sample cans of the final product shall be taken for examiniation. He shall base his decision upon the condition of the boat-load and the report of the inspector. If the boat-load of fish is in a prime state of preservation at the time of packing, the inspection in the plant confirmed this, no samples need be taken.

"2. Sampling shall be carried out according to rules promulgated by the Bureau of Cannery Inspection and the minimum quantities of samples shall be as follows:

"Shipment of less than 200 cases	-	48 cans
200 to 1,000 cases	-	96 cans
1,000 to 2,000 cases	-	192 cans
2,000 to 5,000 cases	-	288 cans
5,000 to 10,000 cases	-	576 cans
Over 10,000 cases	-	960 cans

"Not more than one can should be taken from any one case in sampling.

February 28, 1941."

In actual practice while a state supervisor or inspector may be in a cannery or about the wharfs or premises, he seldom personally makes routine inspection either of the raw fish during butchering or of the precooked fish. This work is generally carried out by one of the cannery personnel for most lots of fish passing through the cannery. Only in cases of suspected spoilage would, as a rule, the state inspector take an active part.

Those tuna which are iced, rather than frozen, sometimes are held long enough for spoilage to develop. Fish frozen aboard clipper ships usually are frozen within such a short period of time that no spoilage can take place. However, in a few instances fish have been allowed to stand on deck in the hot sun for an excessive period of time (in hot equatorial regions this may be only a few hours) and such fish are then partially spoiled before freezing is complete. Spoilage is usually detected during butchering; on rare occasions it may not show up until after precooking either in the form of an off-odor or as honeycombing.

When a state inspector detects spoilage in a lot of fish he advises the cannery to stop packing that lot of fish. In a borderline case the packer may feel that the condition of the fish does not warrant such action and he may continue to pack it. In such a case, samples of the raw fish, or more frequently, of the canned product are shipped to the Fish Laboratory at the Hooper Foundation where both organoleptic and chemical examination of the fish are made. The chemical examination for tuna spoilage consists of the test developed by Dr. Farber of the Hooper Foundation for volatile reducing substances. The test involves the collection of any volatile substances which can be swept away from neutral fish press juices by aeriation. The gases so collected are passed through an alkaline potassium permanganate solution and the excess permanganate determined by titration. Results are expressed as microequivalents per 5 ml. of press juice. For canned tuna, products having less than 15 microequivalents of volatile reducing substances per 5 ml. of press juice are considered acceptable while values in excess of 20 show definite decomposition. Values between 15 and 20 are borderline, indicating fish of questionable acceptability. If the laboratory reports that a lot of fish is not acceptable the State Public Health Department issues an order preventing the fish from being canned, or if already canned, preventing the particular coded lot of canned fish from being marketed. Such fish are usually reduced to fish meal for animal feed.

California sets up the following standards for water used in a fish cannery:

"BACTERIOLOGICAL AND QUALITY STANDARDS FOR WATER USED IN FISH CANNING OPERATIONS

"A) Waters satisfactory without treatment
(1) For whole fish handling operations:
a) Not subject to contamination with human fecal discharges

b) Maximum of 7 E. coli organisms per cc

c) Bacterial standard may be exceeded in not more than 20 percent of the samples

(2) For cut fish handling operations:
a) Not subject to contamination with human fecal discharges

b) Maximum of 7 E. coli organisms per cc

c) Bacterial standard may be exceeded in not more than 5 percent of the samples

"B) Waters satisfactory after treatment
(1) For whole fish handling operations:
a) Not subject to gross contamination with human fecal discharges before treatment

b) Maximum of 3 E. coli organisms per cc after treatment

c) Bacterial standard may be exceeded in not more than 20 percent of the samples

(2) For cut fish handling operations:
a) Not subject to gross contamination with human fecal discharges before treatment

b) Maximum of 3 E. coli organisms per cc after treatment

c) Bacterial standard may be exceed in not more than 5 percent of the samples

d) The treatment shall include filtration or the equivalent as one of the steps of the treatment process

"Samples for bacteriological analysis shall be analyzed by an approved method set forth in the latest edition of the APHA manual entitled "Standard Methods of the Examination of Water & Sewage". Those methods shall be employed which give the most specific reliable means of measuring organisms having their origin in the intestines of man and other warm-blooded animals."

Sanitation in California tuna canneries must conform to practices laid down in "Regulations Governing Minimum Sanitary Requirements for Food Packing Establishments (California Government Code Section 11421)." These requirements pertain to such practices and equipment as drainage and plumbing, ventiliation, construction of floors, walls, and ceilings, etc. One provision specific to tuna canneries is that precooked fish must be cooled in a rodent proof room, a practice not generally followed in other states. In most plants in California a space in a larger room is fenced off with wire meshing for cooling of the racks of tuna from the precooker.

Rigid standards are laid down for the construction and operation of retorts used for canning of tuna. Following is quoted from Sections 21705 and 21706 of the California Public Health Department's Regulations for the Equipment and Operation of Retorts for the Sterilization of Low Acid Foods in Steam or Water:

"21705. REQUIRED EQUIPMENT FOR ALL TYPES OF RETORTS WHEN STERILIZING FOOD IN TIN OR IN GLASS JARS WITH CLOSURES SUCH THAT THEY MAY BE PROCESSED IN STEAM

"(a) Recording Thermometer.

(1) The temperature chart shall be easily readable to 1°F. and shall be graduated in not to exceed 2°F. divisions within the range of plus and minus 10°F. of the official process to be used. All charts shall have a working scale of not less than three inches. Written permission from the State Department of Public Health shall be obtained for the use of old equipment with charts having a working scale of less than three inches. All replacements or new installations shall conform to a minimum three-inch working scale.

(2) No temperature chart shall be used in a recording thermometer unless it is a chart manufactured by or for the manufacturer of the recording thermometer used on the retort.

(3) It shall be unlawful to use charts with the temperature indicated in code.

(4) Every recording thermometer shall bear the name plate of the original manufacturer having the serial number assigned by the manufacturer, and the manufacturer's chart number die stamped thereon.

(5) Any recording thermometer found by a cannery employee or State Cannery Inspector to be faulty in its operation shall be promptly adjusted or replaced by a properly functioning instrument.

(6) Any recording thermometer requiring repair of the thermal system shall be repaired by the manufacturer or a servicing organization accredited by the manufacturer.

(7) Documentary evidence of proper calibration shall accompany any repaired recording thermometer when returned by the manufacturer or accredited servicing organization.

(8) All recording thermometers shall be so placed with respect to light that they are conveniently readable.

"(b) Indicating Mercury Thermometer.

(1) The divisions shall be easily readable to 1°F. and shall not exceed 20°F. per inch of graduated scale. It shall be unlawful to use mercury thermometers with the temperature indicated in code.

(2) All mercury thermometers shall be placed in respect to light so that they are conveniently readable.

"(C) Pressure Gauge.

(1) Every retort shall have a pressure gauge of the Bourdon type in which the operating mechanism is a complete unit independent of the case. Every gauge shall be equipped with a compensating hair spring.

(2) The minimum diameter of the dial shall be 4-1/2 inches.

(3) The range of the pressure scale preferably shall be 0 to 30 pounds, but a range of 0 to 60 pounds may be used.

(4) Any retort pressure gauge found to be inaccurate either by a cannery employee or by a State Cannery Inspector shall be replaced by a properly functioning instrument.

"(d) Valves for Removal of Condensate.

(1) Condensate shall not be allowed to accumulate in horizontal retorts.

NOTE. This may be prevented by the installation of a one-half inch or larger valve in the bottom of the retort to be left open sufficiently during the coming-up time (lag) to remove the condensate.

(2) To assure that condensate will not accumulate in a retort during the process, a one-eight inch or larger petcock or valve shall be installed or a hole drilled in the drain or bottom of the retort and it shall remain open during the entire processing time.

"(e) By-pass Around Diaphragm Control Valve on Steam Inlet.

Each diaphragm control valve shall be equipped with a by-pass o allow for hand control in case of an emergency.

"(f) Steam Inlet.

(1) Horizontal Retorts:
(A) For retorts more than 20 feet in length, the steam shall enter the spreader pipe near the center of the retort. For retorts less than 20 feet in length, the steam may enter the spreader pipe either at the center or at the end. If steam enters at the end, the spreader pipe shall be no smaller than the steam inlet.

(B) The retort shall be equipped with an adequately perforated pipe extending throughout the entire length of the bottom of the retort with perforations arranged so that the steam is directed up and into the load of cans. The ends of the steam spreader shall be closed.

(2) Vertical Retorts:

(A) If steam is admitted into the bottom of the retort, it shall be directed up into the load of cans. Any other position of the steam inlet must be approved by the Department.

NOTE: The recommended number of holes to be used in steam spreaders is given in the following table:

	SIZE OF STEAM SUPPLY INLET					
SIZE HOLES INCHES	3/4 INCH PIPE	1 INCH PIPE	1-1/4 INCH PIPE	1-1/2 INCH PIPE	2 INCH PIPE	2-1/2 INCH PIPE
3/16	25	45	70	112	185	265
7/32	18	35	50	82	135	195
1/4	14	25	38	62	105	145

"(g) Retort Bleeders:

(1) For Horizontal Retort:

(A) A horizontal retort shall be equipped with bleeders along the top of the retort not more than eight feet apart and there shall be one within approximately one foot of each end of the retort. These bleeders shall be kept wide open during the entire process.

(B) Any bleeder at least one-eighth inch in size on a thermometer well may be considered to comply with this requirement when the well is in the top of the retort and located at the proper place.

(2) For Vertical Retort:

(A) A vertical retort shall be equipped with a bleeder at the end of the retort opposite the steam inlet. This bleeder shall be wide open during the entire process. In the case of very small retorts (less than 30 inch diameter and less than four feet in depth) a three-thirty-second inch bleeder may be used.

"(h) Thermometer Bleeders.

Bleeders for All Thermometers on All Types of Retorts.

A one-sixteenth inch or larger bleeder hole shall be kept open for the free escape of steam on all thermometer fittings unless thermometer bulbs are set wholly within the shell of retort proper. The bleeders shall be so located as to provide a full flow of steam past the sensitive part of the thermometer bulb.

"(i) Vents for Removal of Air From Retorts During Coming-Up Period.

Vents shall be installed and operated in such a way that all the air is removed from the retort before timing of the process is started.

"(j) Stacking Equipment for Use in Horizontal and Vertical Retorts.

(1) Stacking equipment (baskets, trays, gondolas, etc.) for all types of containers in discontinuous retorts, when cans or jars are stacked in a vertical position, shall be preferably of strap iron. When perforated sheet metal baskets are used, the perforations in the bottoms shall be at least one inch holes on one and three-fourth inch centers or their equivalent, unless other equipment has been approved.

(2) If dividers are used, they shall be of wide mesh material, such as fish nets or onion sacks, or of strap iron or sheet metal having perforations at least the equivalent of one-inch holes on one and three-fourths inch centers. Close meshed cloth dividers are not permitted.

"21706. ADDITIONAL EQUIPMENT SUGGESTED BUT NOT REQUIRED BY THE STATE DEPARTMENT OF PUBLIC HEALTH

"(a) The use of an additional thermometer on each retort is advised to serve primarily as a check instrument, preferably located adjacent to the temperature recorder bulb.

"(b) An Automatic Temperature Controller is recommended.

"(c) A safety valve of such size and capacity that it meets with the requirements of any Board of Mechanical Engineers or any Safety Code in the State of California, and/or the California Industrial Accident Commission. It is recommended that the safety valve discharge be equal to or greater in capacity than the retort steam supply line."

There is no California State requirement for precooking of tuna. The product must be retorted, however, to the following standards:

Can Size	Process Time in Minutes at			
	230°F.	240°F.	242°F.	250°F.
No. ¼ can	120	65	60	40
No. ½ can	140	75	—	55
No. 1 can	170	95	--	80
No. 4 can	320	230	--	190
2 oz. glass	120	65	—	40
3½ oz. glass	120	65	--	40
7 oz. glass	140	75	—	55
½ lb. glass	140	75	--	55

Most packers use a processing temperature of 240°F. Thus, the common No. ½ tuna can would then be processed for 75 minutes at this temperature.

Tuna packers all seem entirely satisfied with the California State regulations. There seems to be very harmonious relationships between the State supervisors and inspectors in the plant and the management and foremen of the canneries. No dissatisfaction with or critiicism of State regulations was express by anyone in the industry.

Regulations and Standards of Federal Government

Federal standards and inspection of canned tuna are administered by the Food and Drug Administration. At the present time there are no specific standards for canned tuna and any regulations come under the general powers of the agency for the inspection of food. Food and Drug Administration Standards involve: (1) standards of identity (what the particular food is), (2) standards of quality (whether above or below standard), and (3) fill of container (how full the package must be). The standards contemplate in every case that the food is properly prepared from clean, sound materials. The label on the canned product must not misrepresent any fact about the contents of the can, nor can the contents be packed from "filthy or decomposed" food. The can should be filled as full as is practicable with the principal food in the can (in this case tuna). Any packing medium (in this case added oil) should fill only interstices between pieces of the product and must not be used to fill unused head space which could just as well have been filled with the main product. With certain other canned foods, it has been ruled that a minimum of 90% of the volume of the can must be filled with the main foodstuff contained in the can.

The current Food and Drug Administration requirements (United States Food and Drug Administration - 1947) for labeling canned tuna are as follows:

"The common or usual name 'tuna' may be used in labeling fish of the following species:

Species	Common Name in the United States
Germo alalunga	Albacore
Thunnus thynnus	Bluefin tuna
Neothunnus macropterus	Yellowfin tuna
Katsuwonus pelamis	Skipjack or striped tuna

The term 'white meat tuna' may be used on the label of the canned light-colored meat of the albacore (Germo alalunga). The light-colored meat of the other three species, Thunnus thynnus, Neothunnus macropterus, and Katsuwomus pelamis may not be labeled as 'white meat tuna' but may properly be labeled as 'light meat tuna.'

The meat canned from the fish *Sarda chilensis*, commonly known as the bonito or bonita may not be labeled as tuna since it is not a true tuna but must be labeled as bonito or bonita. The meat of *Seriola dorsalis,* commonly known as 'yellowtail' must be labeled as yellowtail and may not be designated as tuna."

The "little tuna" (*Euthynnus alletteratus*)was not included in the Food and Drug Administration requirements which were published in 1947. However, the Food and Drug Administration in a letter dated August 26, 1948, and addressed to the Fish and Wildlife Service, declared: "....... at the present time we are not taking exception to the designation of 'light meat tuna' when applied to the usual oil pack prepared from *Euthynnus alletteratus*."

Inspection of tuna by the Food and Drug Administration also covers the raw fish as received at the cannery and such inspection has been made especially in the case of foreign imports of tuna. Particularly in California with its excellent and complete inspection for spoilage in raw, cooked, and canned tuna the Federal authorities have left such inspection quite largely in the hands of the state. Since states do not make any inspection of imported tuna , the Food and Drug Administration has been active in carrying out such inspection. Imported fish is examined for the presence of off-odors and condemned when found to be spoiled on this basis. The frozen fish are drilled with an electric drill. Heat from the drilling causes any off-odors to be sufficiently volatilized so that they can be detected by a trained inspector.

Immediately after the war when frozen tuna was first imported from Japan spoilage was vitually nil and no fish had to be condemned. Increasing carelessness on the part of the exporters later resulted in considerable spoiled tuna being exported and a number of large batches of fish were condemned. More recently a considerable improvement has been noted and once more occurrence of spoilage in imported frozen Japanese tuna is rare.

The Federal Trade Commission is also concerned with the sale and distribution of tuna and tuna products. However, since the provisions of the Trade Practice Rules for the Tuna Industry promulgated by the Federal Trade Commission are very similar to the requirements of the Food and Drug Administration, the detailed provisions will not be listed.

New Federal Standards for Tuna

In 1925 the Bureau of Chemistry, United States Department of Agriulture, following meetings with the tuna industry, published in its rade Announcements, certain recommendations on the canning of tuna. In art, the recommendations for the No. ½-tuna cans called for a drained eight of not less than 5-3/4 ounces for hand-packed, solid-pack tuna. Machine packing was not used at that time and the chunk and flake type acks were not marketed.) Apparently these recommendations were satisactory as long as the solid-pack tuna was hand packed. However, when he chunk and flake style packs were introduced and the machine packing egan to replace hand packing the absorption of oil by the tuna no longr followed a fixed pattern. Machine packed tuna because of its twisted r distorted fibers absorbs more oil than the hand packed product. Simiarly chunk-pack and flake-pack tuna absorb more oil than the solid-pack. herefore, the drained weight procedures previously used to denote the fill-in" weight of tuna were no longer applicable.

During the past several years the Federal Food and Drug Adminisration has again been working closely with the tuna industry toward ne eventual setting up of standards for canned tuna. Thousands of aboratory tests have been carried out on such subjects as fill of conainer and methods of determining it, and on color determination of the anned product. At the present time these discussions and experiments ave nearly been concluded. Although the final specifications have not een resolved, tentative specifications are under consideration and it is xpected that the final specifications may be adopted sometime during 953. One of the particularly important problems in standardizing canned una products involves the matter of fish "fill-in" weight of the containr. For example, packers have been putting about 5-3/4 ounces of fish nto hand-packed No. ½ tuna cans which are labeled "net contents 7 ounces." achine-packed No. ½ cans may have 5½ ounces "fill-in" weight and sometimes ven less. (These "fill-in" weights represent the precooked loins - not he raw meat.) The fish absorbs sufficient added oil to give a higher rained weight with the machine-packed than with hand-packed fish. Similar elationships hold for the other types of packs.

The ordinary drained weight determination is carried out as follows: he canned product is opened and the contents of the can are placed on a tandard gauge wire screen. The material is allowed to drain a specified ime and the solid material weighed. The weight of the solid material is alled the "drained weight." The drained weight is an estimation of the "fill-in" weight of the canned food material. Determination of drained weight for many canned food products, for example, canned peas, is a simple and fairly accurate procedure. But, in the case of canned tuna, when the ordinary drained weight is determined the oil does not drain completely from the meat. The ordinary drained weight procedure for canned tuna would then obviously give high values which may not be an indication of the "fill-in" weight of tuna meat. The new tuna standards, therefore, must adopt some other criteria for estimating "fill-in" weight. Under consideration is a method of measuring the solid contents of a can of tuna based upon "press weight" determinations. By this method the contents of a can would be subjected to a stipulated pressure in a specially designed press, the expressed liquid separated, and the amount of press cake (solids) determined. The amount of the solid portion of the canned product would serve as an indication of the "fill-in" weight. Stipulated "press weight requirements" would have to be met by each type of pack, such as solid, chunk, flake, and packed with oil or brine.

In general most tuna packers are convinced that the new Federal specifications will be, in the long run, a good thing for the industry. They realize that when the standards are adopted there will be some immediate effects which may seem harmful at the time. These are concerned mainly with the requirements on fill of container which will necessitate increasing the amount of fish in the standard tuna can.

Industry Voluntary Quality Control

In addition to enforced regulations carried out by State and Federal agencies, the industry carries out its own inspection and maintains its own sanitation quality control program at various levels. Many of the canneries have technologists and a few have well-equipped laboratories. These check on yields obtained in the processing of fish and look after sanitation in the plants. They also try to improve on processing methods and develop new products and byproducts. Some of the smaller canneries which have no laboratories or technologists of their own make use of one of the several commercial testing laboratories which operate in southern California. These laboratories will station a worker in a plant to check on weights of product and to collect and carry out cuttings of the product to be certain it is up to required standards.

Most of the tuna canneries are members of the National Canners Association. Starting in 1951 this organization began a series of annual tuna cuttings in southern California. Coded samples from the pack of each cannery are collected and judged for the quality of the pack. At the annual meeting members of the industry are able to see how their own product compares with the average pack in the industry.

CAN MARKETS BE BROADENED BY PACKING OTHER TUNA PRODUCTS?

There are three ways canned tuna can be put up to vary it from the conventional tuna pack. The first of these involves altering the existing tuna product in some minor way such as packing in a can of another size, altering the size of the pieces in the can, or altering the packing medium such as replacing the oil with brine. Minor modifications such as these are treated in greater detail in other sections of this report. (See Chapter I.)

So far as modification of the packing medium is concerned there seems to be no interest in substituting brine for oil by domestic producers. The entire domestic pack is put up at present, in a vegetable oil, usually soya oil except for a small pack of tonno. Tonno is a pack prepared for certain nationality groups in which the vegetable oil is replaced with olive oil (and the salt content is also altered). Two other modifications of the standard pack which are put up in small amounts are dietetic tuna which is put up without salt and has a low oil content, and a baby food made from tuna. Both of these are at present very small volume items which, even if they expand considerably, will never markedly increase tuna consumption.

Two concerns are now adding mono sodium glutamate (MSG) to their product to improve the flavor. This tends to accentuate or bring out the normal tuna flavor. The MSG is added in one plant with the salt, at the other plant separately just after the salt.

A second type of change which can be made is to pack the tuna with some other food ingredient such as noodles to provide the housewife with a prepared recipe which needs only to be heated and served. The tuna packing industry is divided in its opinion about the future possibilities of marketing any substantial quantity of such a product. One opinion, shared by quite a number of members of the industry, is that tuna as now packed is a very versatile product which lends itself easily to preparation in a wide variety of recipes and that each housewife has her own favorite recipes for combining tuna with other foods. It is felt that it is better for the industry to provide the standard pack of tuna which can be used in numerous ways rather than to attempt to provide numerous specially prepared tuna recipes or to try to force the housewife into using one or two standard tuna mixtures ready for use from the can. According to this viewpoint, the consumer can purchase and have on hand a small supply of canned tuna which can be used as occasion demands for a wide variety of dishes. This viewpoint seems to be shared by a majority of those engaged in the industry.

Another opinion was expressed by a few of the packers. This opinion was based on the belief that many consumers are not familiar with the possibility of preparing a low-cost main course dish from canned tuna, and that such persons may look on tuna as a high-cost luxury item. It was contended by these packers that if a quality product such as tuna and noodles was available, ready to heat and serve when it came from the can, many consumers who now looked on tuna as a luxury food would be potential buyers of such a product. These several packers expressed the belief that if such a product could be developed and produced in an efficient manner it might become an item which could be produced in considerable volume and would materially boost the consumption of tuna.

Mixtures of tuna with other foods have been on the market for many years. Packs of tuna and noodles have been marketed by a number of concerns. Other such products include "jellied tuna" (for use in salads) and tuna with string beans. When such products have been put up in the past they have been produced by extremely small producers or as a specialty item without the use of high-speed cannery equipment. This has resulted in excessive production costs and has restricted the sale of these products to a very small volume through delicatessen or other special channels.

It is fairly well agreed in the tuna industry that if such products are to succeed in a big way, it is essential that they be produced in volume using specially designed equipment for filling the cans as well as during other stages of the processing. None of the products of this type have been thus produced to date. One of the larger tuna concerns, however, is experimenting with such a fully mechanized pack. The remainder of the tuna industry is closely watching this development and if it is successful, without doubt there will be other ventures in this field.

The third class of specialty tuna products involves canning a product having entirely different characteristics from the usual pack. This includes such items as tuna spreads, highly seasoned tuna, and smoked canned tuna. Some of these products have been prepared from tuna flakes in an effort to produce a more desirable and higher priced commodity than the low-cost canned flakes.

These products can be produced only for very limited markets. They are used as hors d'oeuvres or for other special purposes where the demand could never be very great. Numerous such products have been and are being produced in a small way. Seldom do such packs exceed a very few thousand cases per year for any one producer. It does not seem likely that production of such items could ever have any very substantial effect upon the consumption of tuna.

A possible impetus to production and marketing of specialty tuna products may result from interest of the United States Armed Forces in purchasing such products for use in rations. Such use of specialty products as tuna and noodles, spiced tuna, or tuna and vegetables, if available at a reasonable cost, would be seriously considered by the Army. This interest on the part of the armed forces might provide an opportunity to the tuna industry to try out on a large scale the marketing of such products.

Furthermore, sale of any form of tuna to the armed forces might have advantages far exceeding the immediate small profits involved. Inclusion of tuna products in such rations might introduce tuna to many individuals who never had tried it and thus serve as an advertisement of such products. Doubtlessly many such men, upon return to civilian life, would be influenced to continue eating tuna and this effect might appreciably increase the sales of tuna in the future.

On the other hand, there are certain requirements involved in packing canned food items for United States Army purchase which lessen the attractiveness of this possible market. For example, the product would have to be put up in cans of special size to fit into the ration cartons; special packing requirements must be met; and certain labor requirements would be specified which may not be in keeping with the present policy of many plants. The uncertainty of continued sale of the product to the Army must also be considered.

SHOULD CANNERIES MOVE TO OTHER LOCATIONS?

Until very recently all the tuna canned commercially in this country was put up in the three western States, California, Oregon, and Washington; by far the largest portion being canned in California. Certain factors encouraged the industry to center in this area. At the start of the tuna industry most of the fish were caught off the coast of California or Lower California which resulted in establishment of the industry in southern California. As the demand for tuna increased, it became necessary to look farther and farther to the south for adequate supplies of fish. Today a substantial part of the catch is taken in Pacific waters off South America which are closer, via the Panama Canal, to certain ports on the Gulf of Mexico and Caribbean Sea than they are to California.

There are certain advantages to the continued processing of this species in California. One such important reason is the location in southern California of several other fisheries which yield a canned product. Both canned pilchard and canned mackerel are produced in considerable volume in southern California. These fisheries tend to complement the production of tuna inasmuch as the canning takes place in the same factories as that of tuna and at times when tuna are not available. The same plant and some of the equipment may be used for canning of mackerel, sardines, or anchovies. Furthermore, it is much easier to have a ready supply of labor available at a moment's notice if that labor can be used throughout the year in the various fisheries. The same people tend to remain over a period of years where there is prospect of fairly steady employment and such labor becomes more skilled than when there is a more rapid turnover. Availability of numerous machine companies and can manufacturers is helpful in the development and upkeep of the canneries.

Because the tuna industry started in southern California, most of the fishermen make their homes in that area and might not wish to locate elsewhere. Since tuna fishing is a highly specialized occupation, availability of experienced tuna fishermen is an important requisite to the establishment of a tuna industry.

One disadvantage to southern California as the center of the tuna industry is the fact that the real big markets for the product are in the eastern section and the urban areas of the central section of the country. This increases the cost of transportation to some extent over that of eastern production. However, transportation costs are a minor part of total costs involved in the price the consumer pays for canned tuna and tunalike products. Another disadvantage has been the movement of the center of fish production to the south.

The tuna industry has considered the possibilities of moving its canneries to other locations, particularly in the Gulf and Caribbean areas. Puerto Rico has a potential advantage not shared by other areas in that under a recent agreement no Federal income tax would have to be paid for tuna produced there within the next few years. Apparently, insofar as the California tuna packers are concerned, the disadvantages more than outweigh the advantages in all Gulf and Caribbean potential locations except in Puerto Rico. In that Territory the tax advantage appears to have made the possibility of tuna operations attractive enough so that, in spite of the various other drawbacks, several California tuna concerns are giving very careful consideration to the possibility of operating in Puerto Rico. Some factors which would influence such a decision are hard to evaluate. For example, labor costs are much lower on an hourly basis in Puerto Rico than in California but productivity may be lower. Distances to be traveled by tuna clippers from the highly productive fishing grounds off Peru and Ecuador are less to Puerto Rico than to southern California, but, the industry points out, in traversing the distance from southern California to South American waters the fishing vessel is continually passing through waters containing tuna and in some voyages may get a full cargo without ever traversing the maximum distance to equatorial waters. Since fishing vessels from Puerto Rico would have to cruise as far as the Panama Canal through presently non-productive tuna waters, they would have to make close to the maximum voyage. These and other perplexing problems make the final decision a difficult one.

Operation in Puerto Rico or other American Gulf ports would permit distribution of tuna without payment of duty of any kind. Operation in South America, on the other hand, requires import duty on the canned product. This, combined with the lack of suitable plant locations, uncertainty of fish supplies, the lack of adequate supply and maintenance services, an uncertain labor supply, and the possibility of future confiscation of plants by foreign governments apparently has not appealed to any of the California producers and none expressed interest in such an operation.

IMPORTED TUNA AS COMPARED TO THE DOMESTIC CATCH

Directly competitive with the tuna produced by the domestic tuna fleet, the nature of which has just been described, are the raw tuna products of foreign producers imported into the United States. By far the major portion of imported raw tuna comes from Japan. Most of the imported Japanese tuna are graded in Japan before shipment so that any fish showing signs of spoilage or bruising caused by improper handling are eliminated. The rejected fish are used in Japan for domestic consumption. At the same time the fish are graded by size so that a shipment usually falls within a very narrow size range. The domestic catch, on the other hand, is not graded in any way before it reaches the cannery, and as a result consists of a wider range of fish sizes and contains a higher proportion of bruised fish.

These factors give most processors a preference for the imported Japanese fish insofar as ease of handling in the plant is concerned. Particularly is the uniformity of size of considerable value. Not only does this make for greater facility in handling but it also increases the yield obtained. This is due largely to the fact that losses during precooking of the fish can be held to a minimum if the sizes of the fish are uniform. When fish of varying sizes have to be cooked together a precooking time long enough to thoroughly cook the largest fish is required. This means that the smaller fish are overcooked and excessive shrinkage has taken place. While it is true that a rough segregation of fish by sizes takes place before putting them in the precooker, a certain variation is bound to occur nevertheless. Pre-grading for size in Japan facilitates this sorting for size as the fish go into the precooker, and enables the operator to work with fish in a much closer range of sizes and thus reduces losses during precooking.

Frozen tuna as shipped from Japan are free of any extensive bruises resulting from poor handling by the fishermen. This may be due more to rejection of bruised fish during grading in Japan than to any more careful handling of the fish by the Japanese fishermen. It sometimes happens, however, that the handling of the frozen fish in transit results in additional bruising. Sometimes the fish are handled several times after arrival in this country. The fish may be unloaded from a vessel in Portland, Oregon or Seattle, Washington, transported to a cold storage warehouse and placed therein. Later they may be taken from cold storage, loaded into a refrigerator car and shipped to Astoria or Grays Harbor and finally unloaded at the tuna cannery. In handling the frozen tuna during such transfers, it is customary for the workmen to use a steel hook on a wooden handle to lift or drag the frozen fish. These are generally applied to the head or tail of the fish. When used carelessly, and especially when the fish are partially thawed, these hooks may cause considerable damage to the fish. Thus when carelessly handled in transportation, Japanese tuna may be more bruised and damaged than local fish. Ordinarily, however, considerable care is taken in handling the frozen tuna, and the Japanese fish are then received in better condition with respect to bruising and similar damage than are domestic tuna.

There is considerable variation in the opinion of tuna packers as to the degree of color difference in the flesh of tuna canned from Japanese and American caught fish. Most packers believe that in a species to species comparison, the color of the flesh of tuna canned from the Japanese fish is lighter than from American caught fish. Some persons interviewed thought that there was a tremendous difference in this respect, others a lesser difference; a few thought there was little or no difference in color. Those who believed that a considerable color difference existed ascribed it to better bleeding of the fish by the Japanese fishermen. Others who found no difference said they were sure the Japanese did not specially bleed their fish. An interesting theory to account for the alleged difference in color was propounded by one of the packers. It was his opinion that Japanese tuna, caught on long-lines, bleed from cuts made by the hook. Because the fish are under the sea water he suggested that the sea water prevented coagulation of the blood and without any special attention by the Japanese fishermen the fish caught on long-lines were thoroughly bled before they were ever lifted from the water.

Recent tests by the Pacific Oceanic Fishery Investigations do not confirm the belief that bleeding the tuna improves the color of the canned product. In these tests tuna of known history were handled in various ways immediately after capture. All possible combinations of bled and unbled, gutted and ungutted, alive and dead fish were used.

An examination of the canned tuna prepared from the various lots of fish indicated that there were no noticeable differences which were caused by the various treatments.

It is generally believed that the flesh of Japanese tuna is firmer than that of American caught fish. This is ascribed to the fact that Japanese tuna are often held in cold storage for many months before they reach the cannery. Although the tuna have been glazed before being placed in cold storage, the glaze soon evaporates at least at certain spots on the fish which may permit rather extensive dehydration to take place. Most packers contacted felt that the texture of tuna canned from Japanese frozen fish was more tough or woody than that from American caught fish. Some also thought that the flavor of the Japanese fish was flat as compared to that canned from domestic fish.

In summary, Japanese caught frozen fish are preferred by most packers primarily on the basis of their having been graded in Japan before export, thus giving fish of more uniform size and with less chance of bruised or partially spoiled fish being included. Some processors believe the color of flesh of tuna canned from Japanese fish is markedly superior to that of flesh from domestic fish. However, most packers prefer the flavor and texture of tuna canned from the domestic fish.

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CHAPTER VI — IMPORTANCE OF THE TUNA INDUSTRY TO THE NATIONAL INTEREST

ABSTRACT

NATIONAL SECURITY IS A MAJOR COMPONENT OF NATIONAL INTEREST. THE TUNA INDUSTRY IS IMPORTANT TO NATIONAL SECURITY. THE SECRETARY OF THE NAVY STATES THAT TUNA FISHING BOATS PROVIDE AN EXCELLENT BACKUP TO PATROL CRAFT IN THE RESERVE FLEET. HE INDICATED THAT FISHING BOATS (INCLUSIVE OF TUNA CRAFT) ARE AN INTEGRAL PART OF NAVY DEPARTMENT PLANNING. THE DEPARTMENT OF THE ARMY STATES THAT IT USES CANNED TUNA IN ITS RATIONS FOR FEEDING TROOPS.

UNDER DATE OF MARCH 5, 1953, THE SELECTIVE SERVICE SYSTEM ISSUED "OPERATIONS BULLETIN NO. 91". THIS BULLETIN, WHICH DETAILS A "MANPOWER POLICY FOR THE COMMERCIAL FISHING INDUSTRY", INDICATES THE IMPORTANCE OF THAT INDUSTRY AS A SOURCE OF FOOD IN THE DEFENSE EFFORT. THE TUNA INDUSTRY IS COVERED BY THIS BULLETIN.

IN NORMAL TIMES THE GREAT TUNA CANNING INDUSTRY, WITH ITS OUTPUT OF PRODUCTS VALUED AT OVER 100 MILLION DOLLARS IN 1950, IS A NOTICEABLE SEGMENT OF THE UNITED STATES ECONOMY. ITS PRODUCTS ARE ALSO BECOMING MORE IMPORTANT AS A FOOD SOURCE IN TIMES OF EMERGENCIES SUCH AS WAR. THIS IS PARTICULARLY TRUE SINCE THE ADVENT OF DECLINING CANNED SALMON PRODUCTION.

MANY ALLIED INDUSTRIES ARE "FED" BY THE TUNA INDUSTRY. NET MANUFACTURE, BOAT MANUFACTURE AND CAN MANUFACTURE ARE BUT A FEW OF THE MANY WHICH BENEFIT FROM THE EXISTENCE OF THE TUNA INDUSTRY.

In approaching this subject there should first be a distinction made between National interest and one of its major components, National security. The latter has to do with the very safety and existence of our Nation. The former has to do with those factors and in addition, other factors such as economic advantages, etc. From the point of view of the Federal Government, National security is the phase of this subject which is the more important. Consequently, the Armed Services' Components, which during past periods of National emergency have relied to some extent on the craft and personnel of the tuna fleet and the plants and personnel of the tuna processing industry, were queried on this subject as it respects National security. Letters were written to the Secretary of the Navy, the Chief of Transportation in the Department of Army, and the Quartermaster General. The following replies were received:

DEPARTMENT OF THE NAVY
(COPY) Office of the Secretary
WASHINGTON

15 Jan 1953

My dear Mr.Secretary:

Your letter of 18 December 1952 requested the views of the Department of the Navy concerning the importance of the tuna industry from the standpoint of national security.

fishing
The Department of the Navy considers the domestic tuna/fleet an important facet in the national security. This may be divided into three categories in the event of an emergency, namely:

a. Domestic tuna products as a source of food.
b. The fishermen as a source of manpower for mobilization.
c. The fishing boats as a means of augmenting naval patrol craft.

The first two categories are self evident. As for the third category, the requisition of a number of fishing boats may be necessary to augment the naval forces that our national economy can support. The Department of the Navy is much better prepared than prior to World War II in availability of patrol craft due to the number of vessels in the Reserve Fleet. However, these vessels are approaching the end of their useful life. The tuna fishing boats provide an excellent back up. These boats could be converted for limited anti-submarine warfare, harbor patrol, mine warfare, and picket boat operations. The Department of the Navy has completed an initial study of methods of utilization and conversion of small naval craft to augment anti-submarine warfare operational capabilities. The study is applicable to comparable size fishing boats.

It is hoped that this information will assist in the study of the tuna industry.

Sincerely,

Honorable Oscar L.Chapman /s/ Dan A.Kimball
Secretary of the Interior
Washington 25, D.C.

DEPARTMENT OF THE ARMY
(COPY) Office of the Chief of Transportation
WASHINGTON 25, D. C.

TCTER HB (OCT 381) Feb 26 1953

Director, Fish and Wildlife Service
Department of the Interior
Washington 25, D. D.

Dear Sir:

This acknowledges receipt of your letter of 10 February 1953, File number 717, relative to the importance of the tuna industry from the standpoint of national security and to possible use by the Transportation Corps of tuna clippers and their crews in case of extreme emergency.

The importance of tuna fish and its products as a aource of food for this nation cannot be questioned. The size of the domestic tuna fleet, which numbers more than two hundred active boats of both wood and steel construction ranging up to 140 feet in length, attests to that fact.

With respect to possible use of units of the domestic tuna fleet by the Transportation Corps in a national emergency, the following information is furnished. Since World War II the responsibilities for controlled mine planting activities have been transferred from the Department of the Army to the Department of the Navy. The functions of moving military personnel and supplies coastwise, overseas and within Theaters of Operation have been transferred to the Military Sea Transportation Service of the Department of the Navy. The present water transportation responsibilities of the Transportation Corps are discharged within harbor areas, on inland waterways or on other relatively sheltered waters.

From the above it is apparent that the types and sizes of vessels required by the Transportation Corps in performing its present mission differ greatly from those used in World War II. In addition, the current new vessel procurement program of the Transportation Corps is aimed at acquiring sufficient craft of the various types necessary to discharge its responsibilities in the event of national emergency. It is therefore not anticipated that the Transportation Corps will require any great number of units of the tuna fleet in the forseeable future. This, of course, is predicated upon an unchanged mission on or subsequent to any future mobilization date.

With regard to possible use of tuna fleet crews, it is difficult to estimate the manpower requirements for manning of Transportation Corps vessels in case of national emergency. It can be said, however, that military personnel are being trained to the maximum extent practicable with existing equipment and facilities to discharge Transportation Corps responsibilities overseas in the operation of its vessels. It is the policy of the Transportation Corps, however, to use civilian crews within the Continental United States for operation of its vessels wherever practicable. This policy is expected to continue in case of future national emergency, providing civilian crews can be made available. In such emergency, the skilled crews of the tuna fleet might well be utilized to augment existing Transportation Corps civilian crews within the Continental United States and in the delivery to Oversea Commands of such vessels as are capable of proceeding under their own power.

I trust that this reply gives you the desired information. Your interest in calling the matter to my attention is appreciated.

Sincerely yours,

/s/ F.A.Heileman

F.A.HEILEMAN
Major General, USA
Chief of Transportation

DEPARTMENT OF THE ARMY
(COPY) Office of the Quartermaster General
WASHINGTON 25, D.C.

In reply refer to
QMGIF 431 Fish and Wildlife Service

24 February 1953

Director
Fish and Wildlife Service
United States Department of the Interior
Washington 25, D.C.

Dear Sir:

Your letter of 9 February 1953 requesting a statement of our views concerning the importance of the tuna industry from the standpoint of national security has been received.

This Office is not in a position to make a determination of the ramifications involved in the relation of the tuna industry to national security. However, information related to consumption of tuna, its acceptance by Army personnel, and its nutritional qualities is available and is submitted for your information.

From the viewpoint of consumption, tuna has been placed on the Joint Army-Air Force Master Menu eight (8) times per year for the years 1953 and 1954. Frequency of serving any item is determined by its acceptability, nutritional qualities, availability and price. Installation commanders are authorized, however, through their local Menu Boards to change menus as published by the Office of the Quartermaster General, based on local conditions.

Total quantity of tuna fish issued from depots in the continental United States for consumption both overseas and in the United States over the past three years is as follows:

1950	1,256,000 lbs
1951	1,907,000 lbs
1952	2,911,000 lbs

Nutritionally, tuna is classified as a protein food as are other meat, fish and poultry products. Consequently, although it is desirable to retain tuna as a menu item for the purpose of maintaining variety, substitution of another protein in event of short supply of tuna would not present a significant problem.

At the present time, this Office is not procuring canned fish for foreign relief feeding, nor are any procurements contemplated at this time.

In summary, to the knowledge of this Office, no problem has existed in the availability of adequate amounts of fish (canned or fresh) to meet any reasonable supply demand.

Sincerely yours,

/s/ Wm.J.McDonald
WM.J. McDONALD
Colonel, QMC
Executive Officer

In addition to this information with respect to National security, there is one further fact which should be mentioned. Under date of March 5,1953, the Selective Service System issued "Operations Bulletin No.91". This bulletin indicates the importance of the commercial fishing industry to the National economy and the defense effort. It reads as follows:

"OPERATIONS BULLETIN No.91
SUBJECT: MANPOWER POLICY FOR THE COMMERCIAL FISHING INDUSTRY

"1. Since food has its source in commercial fishing as well as in agriculture, the principles relating to agricultural manpower contained in the attachments to Operations Bulletin No.72, Subject: Policy on Agricultural Manpower, shall be applied in the classification of registrants engaged in the commercial fishing industry. Local boards may contact the Defense Fisheries Administration, U. S. Department of Interior, through its field offices listed below, which, when requested, will furnish information as to the essentiality of registrants engaged in the commercial fishing industry.....

"2. On questions of fishery manpower matters affecting states not mentioned above, the Defense Fisheries Administration, U. S. Department of the Interior, Washington 25, D. C. may be contacted.

(signed) Lewis B. Hershey
DIRECTOR"

With the issuance of this bulletin more detailed consideration in the selection of commercial fishermen by the Selective Service System will result. This is a realization of the importance of the commercial fishing industry as a food source in the defense effort. Although not specifically mentioned, the tuna fishing industry is part of this overall group.

As far as the economic aspects of the National interest, with respect to the tuna fleet are concerned, there are many factors to be considered. First, there is the fact that the tuna resource is one that is available for the most part free to all nations of the world. The United States, by prosecuting a tuna fishery, stands to benefit to some extent from that free resource. Second, the employment of labor on boats and in allied industries must be considered. Beyond that the opportunity for businessmen to engage in businesses which are afforded by the tuna fishing industry must not be overlooked. All these and more favorably affect the National interest.

At the present time with the economy of the Nation functioning in high gear as a result of the Defense Program the existence or loss of the tuna fishing industry would not have a pronounced effect on the economy of the Nation. However, the problem should also be approached from the long-range point of view. Under normal conditions, in the absence of war or National emergency, the United States economy can not be expected to function in the same way as it does at present under the Defense Program. There is hardly a question but that at such time the Nation would appreciate having a tuna fishing industry to provide employment for labor and to afford the Nation some benefit from a great world food resource which is free for the taking.

In its record production year, 1950, the tuna fleet produced fish valued at $61,419,000. It was the vital base for the processing industry which turned out products valued at over $190,000,000 in that year. Production of that magnitude with attendant thousands of workers would be particularly significant, especially in a normal peacetime economy.

Some idea as to the Department of Labor's view with respect to the tuna industry and the National interest were given in reply to a query on this subject addressed to that Department. The reply from the Department of Labor is reproduced as follows:

U.S. DEPARTMENT OF LABOR
Office of International Labor Affairs
WASHINGTON

(COPY)

Office of the Director

March 2,1953

Mr. Albert M. Day
Director
Fish and Wildlife Service
Department of Interior
Washington 25, D. C.

REF: File 717

Dear Mr. Day:

Please find attached a brief statement covering some of your questions on fishing and canning of tuna. This statement was prepared by the Bureau of Employment Security of the Department of Labor.

If you have additional questions, please let me know.

Sincerely yours,

/s/ Philip Arnow
Philip Arnow
Associate Director

Enclosure

(COPY)

NOTES ON TUNA FISHING AND CANNING INDUSTRIES IN SELECTED AREAS

Los Angeles Area

Fishing and fish canning employment represents less than three-tenths of one percent of total employment in the Los Angeles area. In December 1952, 2,000 were engaged in fishing, while 4,200 were employed in fish canneries. This is not significantly different from conditions in December 1951. Employment declines have been reported in some larger fish canneries, however, due to mechanization. Much of the solid pack process has been converted to chunk and grated pack through the use of machinery, which saves time over the hand-pack methods previously used.

Despite the small percentage of area workers involved in fishing or fish canning and the abundance of job opportunities to be found in the Los Angeles area -- particularly in aircraft and related activities -- a sharp drop in fishing would create high unemployment among workers attached to this industry. The major reasons for this situation are age, language barriers, attachment to the industry, and limited work experience in other fields.

Most workers in these industries entered their occupations at an early age and through family ties. Available information on tuna fisherman shows that over one-third are past 50 years of age, and less than one-sixth under 30. For the area as a whole, less than three-tenths of all workers are past 50, and close to one-third below 30. This older age would prove a handicap in obtaining other jobs. Also, many of the workers can communicate effectively only in a language other than English. This problem is further complicated by the fact that a number of languages other than English are spoken so that fishermen and cannery workers cannot even transfer readily from boat to boat or plant to plant but must work within a group where they can be assisted in their communications with others. Transfer to other industries is greatly impeded. The limited work experience of these workers also hampers any shift to other jobs. The skills of commercial fishermen are peculiar to the industry and cannot be fully utilized elsewhere. Industries that might absorb these workers as laborers are petroleum production and refining, and shipbuilding. They might also find dock work as riggers or longshoreman. None of these industries are expanding and an adequate supply of experienced workers is available.

Training and readjustment would be difficult from the standpoint of both the fishermen and prospective employers. Also, many fishermen own homes in the harbor area, while major expanding industries are at distant points in the Los Angeles area, with public transportation facilities limited. Even if these fishermen could find work in other industries, their earnings would doubtless be significantly below what they could make fishing.

Cannery workers are predominantly women, but similar language, age, and other barriers exist. Very little related work is available. Most canneries have a fixed labor force, not readily adaptable to other jobs. No other food processing and packing plants are located nearby.

San Diego Area

In December 1952, around 800 workers were engaged in fishing, and 700 in fish canning. This industry is highly seasonal, however, and December is normally a low month. In July and August, about 2,500 workers enter the area during albacore runs.

The current situation is not markedly different than in December 1951. Fishing employment was slightly lower, but cannery employment was twice as great. By mid-January, however, canning employment was below the level one year earlier, with most canneries on a stand-by basis awaiting return of tuna boats.

Fishermen in this area, as in Los Angeles, could not be readily absorbed into other lines. Most are over 35 years of age, with skills and experience not easily adapted to other jobs. Some could be used in shipyards for repair work, and many do find such work during layoffs. A few fishermen have given up their trade, despite the high monetary returns, to remain in shipyard work. Shipyards still complain about loss of workers when fishing picks up, however. A few fishermen have also been going into small businesses of their own. However, it is the concensus of opinion, both management and labor, that if large numbers were to become unemployed the majority would remain so until their unemployment benefits expired and probably would eventually leave for other fishing areas. Age, monetary considerations, language barriers and lack of necessary skills, along with lack of citizenship, make it doubtful if many would desire or could obtain jobs in the expanding defense plants of the San Diego area.

San Francisco Area

In this area, evidence indicates tuna fishing has been declining since 1950. Canneries have not been significantly affected in terms of employment because of importation of tuna from the Central Pacific, Australia, Japan, and Peru, although many firms have found operations less profitable. Because of dependence upon foreign tuna purchased on the open market, they have been unable to plan ahead with any accuracy, and employment has been less stable.

To some extent, technological developments are believed to have affected tuna fishing. Modern equipment -- including refrigeration, automatic steering, depth and direction finding, and two-way radio -- has enabled boats to stay at sea longer and troll greater distances. Owners have found that they can accomplish the same work with smaller, less experienced crews. Fewer skilled fishermen are needed. Unions claim that the practice of hiring family members or men interested in adventure has been on the rise, with fewer skilled fishermen needed, and that owners have justified the change on the basis of the lower prices they receive for tuna and increased operating expenses.

To some extent, the decline in tuna fishing in this area has been offset by increased fishing for tuna by boats formerly engaged in sardine fishing. Sardine catches, particularly in the Monterey area, have fallen off sharply in recent years.

Fishermen in this area have been more fortunate than in most others in obtaining other work. They are members of the International Longshoremen's and Warehousemen's Union, and many have been placed in stevedoring and longshoring jobs. These jobs are dependent on war contracts, however, and most fishermen would be displaced by other union members with longer seniority if these contracts were terminated or sharply reduced. Also, the work is not steady and does not compensate for losses of wages due to lack of fishing.

As in other areas, the average age of fishermen is high-- believed to be around 50 years. Younger fishermen, usually sons of fishermen or boat owners, have found work on shore easier and wages better due to reduced earnings in the declining tuna industry. Most younger fishermen are native born. Older workers, because of language, age, and training handicaps, and lack of citizenship, have difficulty switching to land occupations. They can find work usually only in stevedoring, longshoring, rigging, and ship repair and boilermaking.

Other California Areas

No tuna fleet, as such, is located in northern California. Declines in tuna would probably not severely affect these areas. Most fishermen normally fish for other species, although some are equipped for tuna and occasionally fish for tuna in southern waters or during runs in northern waters. During 1952, there were few tuna runs in the north, and only a few tons were processed in northern plants -- principally at Eureka.

Fishermen in northern California, unlike those in the south, are largely self-employed on their own boats. They are busy during runs of sardines, anchovies, or squid, and find work in the off-season in farming, construction, or similar activities. During some seasons, these boats shift to Alaskan waters for salmon, or to South America or Mexico for tuna. The virtual disappearance of sardines in recent years has caused a decline in fishing employment.

Declines in tuna would largely cause increased fishing in other species. Should this not be possible, fishermen would probably operate pleasure boats, move to other fishing areas, or find work in farming, construction, or fresh vegetable packing. Unemployment of fishermen in northern California is practically nonexistent at the present time.

Washington and Oregon Areas

While no information is available on fishing in Washington and Oregon, conditions are believed similar to those in northern California with tuna fishing of secondary importance.

General

Commercial Fishing is classified as an Essential Activity. This would, of course, include fishing for tuna. The List of Critical Occupations includes all Masters and Pilots on commercial fishing vessels as well as licensed mates and engineers on such vessels.

The lists of Essential Activities and Critical Occupations are prepared by an Interdepartmental Committee on Essential Activities and Critical Occupations and jointly issued by the Secretaries of Commerce and Labor. The Department of Defense, the Selective Service System, and the Defense Manpower Administration in the Department of Labor use these lists in determining policy in calling reservists to active duty, making determinations on requests for occupational deferment, and in the priority of referral of workers to essential establishments in shortage areas.

(End of statement prepared for the U.S.Department of Labor - Office of International Labor Affairs).

In addition to employment for labor in the tuna fishing industry,
mployment in allied industries stems from the existence of tuna fishing.
he great tuna canning industry also is based to a considerable extent
n the existence of a domestic tuna fishing fleet. It, together with its
llied industries, provides further employment for United States labor.
ll of these industries offer a great field for the endeavors of business-
en. The loss of them in normal times would unquestionably be noticed
n the economy of the Nation.

During World War II certain canned fish such as salmon and sardines
ere placed under set-aside orders by the War Food Administration. Such
ction made it mandatory for packers to furnish a sizable percentage of
heir pack to the National Government for its use in prosecuting the war
ffort. Although tuna was not included in such action, it is a type of
roduct which serves the same purpose as was intended for the products
laced under set-aside orders. The declining production trend for salmon
nd the increasing production trend for tuna has made it likely that the
atter will be a more important source of canned fish for any present or
uture emergencies such as were encountered in World War II. Such indi-
ations are evidence of the future importance of the tuna processing in-
ustry to the National security in time of war.

When viewed from the other aspects of National interest -- the econ-
mic aspects -- the processing industry also takes on great importance.
una processing provides employment for a large number of persons, par-
icularly on the west coast. It offers opportunity for business enter-
rise to engage in entrepreneural risks with attendant remuneration for
uccessful prosecution of these risks.

In connection with tuna canning operations and tuna fishing activity allied industries, such as can manufacturers, label manufacturers, machinery manufacturers, net manufacturers, boat builders, hardware supplies etc., are provided with markets and resultant business activity and employment in those industries. All these together in times of normal economic activity in the United States add to the National well-being. The loss of them in normal times would be noticed in the economy of the Nation.

CHAPTER VII -- DISTRIBUTION

ABSTRACT

OF THE THREE PRINCIPAL ECONOMIC FUNCTIONS IN BRINGING CANNED TUNA TO THE CONSUMER, NAMELY, PRODUCTION, PROCESSING, AND DISTRIBUTION, THE LATTER TAKES A SMALLER SHARE OF THE CONSUMER'S DOLLAR THAN EACH OF THE OTHER TWO. TRANSPORTATION, WAREHOUSING, WHOLESALING AND RETAILING ARE THE PRINCIPAL SUB-FUNCTIONS IN DISTRIBUTION.

THERE ARE THREE PRINCIPAL TRANSPORTATION FACILITIES USED TO BRING CANNED TUNA FROM PROCESSOR TO MARKET, NAMELY, RAILROAD, TRUCK, AND INTERCOASTAL BOAT. THE GREATEST VOLUME OF CANNED TUNA MOVES VIA RAILROAD DESTINED FOR MOST OF THE MAJOR DISTRIBUTION CENTERS IN THE UNITED STATES. CANNED TUNA SHIPMENTS TO LARGE CITIES ON THE WEST COAST ARE HANDLED PREDOMINANTLY BY TRUCK. A SMALL PERCENTAGE OF CANNED TUNA IS SHIPPED TO ATLANTIC PORTS VIA INTER-COASTAL BOAT, UTILIZING LOW RATES AND LOW MINIMUM CARLOAD REQUIREMENTS.

RAILROAD TRANSPORTATION RATES FOR MANY FOOD COMMODITIES INCREASED MORE THAN DID RAILROAD RATES FOR CANNED TUNA IN THE PERIOD 1950 THROUGH 1952. IN GENERAL, TRANSPORTATION CHARGES FOR CANNED TUNA FROM 1950 THROUGH 1952 WERE RELATIVELY LOW, RANGING FROM 0.5 PERCENT OF RETAIL VALUE TO 3.22 PERCENT OF RETAIL VALUE FOR VARIOUS TYPES OF MOVEMENTS STUDIED.

WHOLESALE MARKETING PROCEDURES ARE BEING IMPROVED WITH MANY NEW METHODS THAT FOCUS ON ADJUSTMENTS IN MERCHANDISING POLICIES AND PHYSICAL OPERATIONS. IMPROVEMENTS HAVE BEEN INITIATED TO CUT COSTS OF TAKING AND ASSEMBLING ORDERS; TO PROVIDE SEPARATE ARRANGEMENTS FOR HANDLING SPECIAL ORDERS; AND TO STRIVE FOR BETTER INTEGRATION OF PLANT AND WORKER SO THAT JOB TIMING WILL BE THE MOST EFFICIENT.

WHOLESALERS STOCKING CANNED TUNA HANDLE IT IN AN IDENTICAL MANNER TO HUNDREDS OF OTHER CANNED COMMODITIES. THEREFORE, AN IMPROVEMENT IN THE OVERALL PHYSICAL OPERATION OF WAREHOUSING WILL BE AN IMPROVEMENT IN CANNED TUNA'S WHOLESALE MARKETING.

THE MARKED GROWTH OF THE "SUPERMARKET" TYPE GROCER AND CHAIN STORE OPERATIONS HAVE FORCED IMPROVEMENTS IN RETAIL MARKETING PROCEDURE. EFFORTS HAVE BEEN DIRECTED TOWARD IMPROVEMENTS IN THE PHYSICAL HANDLING OF GROCERIES AND MERCHANDISING RESEARCH. ANY COST REDUCING INNOVATION BY RETAIL GROCERS WILL BE TO SOME DEGREE AN IMPROVEMENT IN THE RETAILING OF CANNED TUNA.

WHOLESALE AND RETAIL MARKETING OF CANNED TUNA IS ONLY A PART OF THE OVERALL OPERATION OF FIRMS IN THESE FIELDS. THE ESSENTIAL PROBLEM OF WHOLESALING AND RETAILING IS NOT ONE THAT CAN BE RESOLVED IN TERMS OF ANY ONE PARTICULAR PRODUCT. THE PROBLEM CONFRONTING BOTH WHOLESALER AND RETAILER IS THE GENERAL MOVEMENT OF NUMEROUS PRODUCTS AND NOT JUST THE SPECIFIC MOVEMENT OF CANNED TUNA. IN HANDLING CANNED TUNA WHOLESALERS AND RETAILERS APPEAR TO HAVE SOLD THIS COMMODITY AT LOWER RELATIVE MARGINS THAN CANNED FISH ITEMS HANDLED.

NINETY PERCENT OF ALL DOMESTIC TUNA IS PACKED IN THE STATE OF CALIFORNIA, OF WHICH 70 PERCENT IS PROCESSED BY THREE LARGE CONCERNS. THE GREATEST PORTION OF THE PACK IS SOLD THROUGH FOOD BROKERS, WHO RECEIVE A THREE PERCENT COMMISSION ON THE FACE VALUE OF INVOICES. PRICES CHARGED ARE F.O.B. PLANT, WITH THE TRANSPORTATION COST ADDED TO THE BUYER'S INVOICE. MOST PACKERS SELL ON A CASH BASIS ALLOWING SMALL DISCOUNTS FOR PROMPT PAYMENT OF BILLS. PRINCIPAL PURCHASERS OF CANNED TUNA ARE WHOLESALERS, RETAIL-OWNED COOPERATIVES, AND CHAIN STORES. A NOTABLE TREND IS THE INCREASED VOLUME SOLD TO CHAIN STORES IN POST WAR YEARS.

LARGER TUNA PACKING CONCERNS EXTEND A FLOOR STOCKS GUARANTEE WHICH IS A GUARANTEE TO THE PURCHASERS AGAINST A PACKER'S REDUCTION IN PRICES WITHIN A LIMITED PERIOD OF TIME.

DIRECT ADVERTISING BY TUNA PROCESSORS CONSISTS MOSTLY OF NAME BRAND PROMOTION CONDUCTED NATIONALLY. MILLIONS OF DOLLARS YEARLY ARE SPENT FOR THIS PURPOSE. SOME LARGE COMPANIES ENGAGE IN COOPERATIVE ADVERTISING AGREEMENTS THAT STIPULATE THE PROCESSOR WILL PAY THE BUYER A CERTAIN SUM PER CASE ON PROOF THAT THE BUYER HAS ADVERTISED THE PROCESSOR'S BRAND.

LARGE PROCESSORS WAREHOUSE CANNED TUNA IN COMMERCIAL WAREHOUSES AT VARIOUS DISTRIBUTION CENTERS THROUGHOUT THE NATION SO AS TO SHORTEN TIME INTERVAL TAKEN FOR DELIVERY OF ORDERS TO BUYERS.

EXCEPT FOR CALIFORNIA PACK, DATA ARE NOT GENERALLY PUBLISHED ON A CURRENT BASIS. INFORMATION ON STOCKS IS LACKING AT ALL LEVELS EXCEPT FOR PRIVATE DATA AT THE CANNER'S LEVEL COLLECTED BY A CALIFORNIA PACKERS' ORGANIZATION. PERIODIC STUDIES OF THE REGIONAL CONSUMPTION OF CANNED TUNA ALSO ARE LACKING. PRICE DATA AT THE WHOLESALE LEVEL IS COLLECTED BY THE FISH AND WILDLIFE SERVICE FOR THE UNITED STATES BUREAU OF LABOR STATISTICS' INDEX OF WHOLESALE PRICES.

CHARGES FOR DISTRIBUTION AND OTHER PRINCIPAL ECONOMIC FUNCTIONS

During this survey it was desired to obtain some idea of the relation of the total charges made for the distribution of the processed products of the tuna industry to the charges made for the other principal economic functions in bringing the products of the industry to consumers. A breakdown of the percentages of the consumer's dollar which went as compensation for the principal economic functions was sought. Considerable data were obtained which provide information with respect to the percentages of the consumer's dollar used in recent years for these principal functions -- production, processing, and distribution.

Again as in the chapter on Consumption it might be observed that the products of the tuna industry are practically synonymous with canned tuna and tunalike fishes. Some information with respect to retail prices paid by consumers for canned tuna in recent years is given in table 79. In this table average retail prices in selected cities for retail sales of the solid pack, light-meat No.1/2 can of tuna are shown for the years 1950, 1951, and 1952. These retail price data were obtained by the United States Bureau of Labor Statistics and the Fish and Wildlife Service. Further data on retail prices of canned tuna are available from both these Bureaus, but the cities shown in the table have been selected for the purpose of this survey because they best illustrate certain types of distribution to be described in ensuing pages.

TABLE 79. - ANNUAL AVERAGE RETAIL PRICE, SOLID PACK, LIGHT-MEAT, FANCY NO.1/2 CAN TUNA IN SELECTED CITIES OF THE UNITED STATES, 1950-1952

CITY	AVERAGE RETAIL PRICE		
	1950	1951	1952
	Cents	Cents	Cents
Boston, Massachusetts	34.9	37.3	32.8
New York, New York	40.5 1/	37.0	35.3
Washington, D. C.	41.9 2/	37.8	39.1
Atlanta, Georgia	40.9 1/	37.5	38.1
Dallas, Texas	44.2	---	---
Houston, Texas	---	35.6	39.0 2/
Chicago, Illinois	40.8 2/	39.6	37.7 2/
San Francisco, California	41.5 2/	35.7	38.9

1/ April - December (9 months).
2/ February - December (11 months).
SOURCE: United States Bureau of Labor Statistics and United States Fish and Wildlife Service.

The retail price data were matched with appropriate data indicating what parts of the retail price were received by producers (fishermen), processors, and distribution agencies. These data are shown in table 80 which provides information for West Coast produced and processed canned tuna and in table 81 which gives information for East Coast processed canned tuna. In table 80 it will be noted that the amount taken for distribution is the smallest of the three shares. For table 81 no data were available for the remuneration to fishermen. A large portion of the raw fish used by East Coast packers is caught by foreign fishermen, whereas the reverse is true for the pack made on the West Coast.

Production of solid pack, light-meat canned tuna which consists predominantly of the No.1/2 or 7-ounce can, accounted for about 26 percent of the domestic pack of canned tuna in 1950, 22 percent in 1951 and 16 percent in 1952. Distribution of this particular product accounted for about the same percentages of total distribution of canned tuna. Although that commodity only accounts for those approximate percentages of the total canned tuna pack and total

TABLE 80. - ESTIMATED SHARES OF CONSUMER EXPENDITURES OBTAINED BY WEST COAST PRODUCERS AND PROCESSORS AND ALL DISTRIBUTORS, FOR CANNED TUNA PRODUCED AND PROCESSED ON THE WEST COAST AND RETAILED IN VERIOUS SELECTED CITIES, ANNUAL AVERAGES: 1950 - 1952 1/

CITY	YEAR	PRODUCERS SHARE		PROCESSORS SHARE		DISTRIBUTORS SHARE		AVERAGE RETAIL PRICE PAID BY CONSUMERS	
		Dollars per case	Percent of retail	Dollars per case	Percent of retail	Dollars per case	Percent of retail	Dollars per case	Cents per can
Boston, Mass.	1950	7.24	43.2	6.20	37.0	3.31	19.8	16.75	34.9
	1951	7.29	40.7	6.41	35.8	4.20	23.5	17.90	37.3
	1952	7.16	45.5	7.16	45.5	1.42	9.0	15.74	32.8
New York, N.Y.	1950	7.24	37.3	6.20	31.9	6.00	30.8	19.44	40.5 2/
	1951	7.29	41.1	6.41	35.9	4.06	23.0	17.76	37.0
	1952	7.16	42.3	7.16	42.3	2.62	15.4	16.94	35.3
Washington, D.C.	1950	7.24	36.0	6.20	30.8	6.67	33.2	20.11	41.9 3/
	1951	7.29	40.2	6.41	35.3	4.44	24.5	18.14	37.8
	1952	7.16	38.2	7.16	38.2	4.44	23.6	18.76	39.1
Atlanta, Ga.	1950	7.24	36.9	6.20	31.6	6.19	31.5	19.63	40.9 2/
	1951	7.29	40.5	6.41	35.5	4.30	24.0	18.00	37.5
	1952	7.16	39.2	7.16	39.2	3.96	21.6	18.28	38.1
Dallas 4/ and Houston, Tex.	1950	7.24	34.1	6.20	29.2	7.77	36.7	21.21	44.2
	1951	7.29	42.7	6.41	37.5	3.38	19.8	17.08	35.6
	1952	7.16	38.2	7.16	38.2	4.40	23.6	18.72	39.0 3/
Chicago, Ill.	1950	7.24	36.9	6.20	31.6	6.14	31.5	19.58	40.8 3/
	1951	7.29	38.4	6.41	33.7	5.30	27.9	19.00	39.6
	1952	7.16	39.6	7.16	39.6	3.77	20.8	18.09	37.7 3/
San Francisco, Cal.	1950	7.24	36.4	6.20	31.1	5.48	32.5	19.92	41.5 2/
	1951	7.29	42.5	6.41	37.4	3.44	20.1	17.14	35.7
	1952	7.16	38.4	7.16	38.4	4.34	23.2	18.67	38.9

1/ Based on sales of solid pack, fancy, ~~light~~meat, No.1/2 can tuna. These are gross shares and include predominantly costs of labor, supplies, materials, etc. 2/ April-December (9 months). 3/ February-December (11 months). 4/ Dallas, Texas for 1950 and Houston, Texas for 1951-1952.

SOURCE: Compiled by United States Fish and Wildlife Service.

TABLE 81. - ESTIMATED SHARES OF CONSUMER EXPENDITURES OBTAINED BY EAST COAST PROCESSORS (AND THEIR RAW FISH SUPPLIERS) AND ALL DISTRIBUTORS, FOR CANNED TUNA PROCESSED ON THE EAST COAST AND RETAILED IN NEW YORK, NEW YORK, ANNUAL AVERAGES 1950-1952. 1/

CITY	YEAR	PROCESSORS AND PRODUCERS SHARES		DISTRIBUTORS SHARE		AVERAGE RETAIL PRICE PAID BY CONSUMERS	
		Dollars per case	Percent of Retail	Dollars per case	Percent of retail	Dollars per case	Cents per can
New York, N. Y.	1950	11.67	60.0	7.77	40.0	19.44	40.5 2/
	1951	12.16	68.5	5.60	31.5	17.76	37.0
	1952	11.84	69.9	5.10	30.1	16.94	35.3

1/ Based on sales of solid pack, fancy, light-meat, No.1/2 can tuna. These are gross shares and include predominantly costs of labor, supplies, materials, etc.

2/ April-December (9 months).

SOURCE: Compiled by United States Fish and Wildlife Service.

distribution of domestic canned tuna products, it was selected for study because considerable retail price data were already available from the United States Bureau of Labor Statistics. In addition, it is felt that it is typical of the distribution of the bulk of domestically canned tuna products. With this in mind, the percentages of the consumer's dollar distributed to the principal economic functions as shown for that commodity, in general, may be considered to be typical for the majority of canned tuna products. For the lower priced canned tuna products such as grated tuna an d for tunalike products the picture will be somewhat the same although fixed distribution charges, such as transportation, which are the same regardless of the value of the product tend to exact a greater share of consumers' expenditures for those lower priced products.

The share of the consumer's dollar for West Coast canned tuna that distribution takes in relation to the other shares is shown graphically for the three years 1950-1952 and for three selected cities in figure 16. The distribution function breaks down into many sub-functions each of which receives a part of this share. Transportation, warehousing, wholesaling, and retailing are the principal sub-functions. These will be discussed in ensuing pages. Since transportation is the processor's first physical contact with the distribution channel, that sub-function will be discussed first along with the related item, warehousing.

Transporting[23] and Storing Tuna

TRANSPORTATION

Of the total 1952 domestic pack of canned tuna about 2 percent was processed on the Gulf and Atlantic coasts and 98 percent[24] on the West Coast. Most of the canned pack in the former area is shipped via railroad and truck with the predominant part moving by the latter medium. Canned tuna is shipped from the West Coast to the various cities throughout the country by railroad, truck, and boat. The greatest volume of the pack of that area is moved via railroads. A much smaller portion is moved by truck principally to West Coast consuming areas and in post-war years, the West Coast canners have been reviving the pre-war practice of utilizing boats, with the predominant part of those shipments going to northeastern United States.

Five canning companies packed approximately 70 percent of all the light-meat, solid pack, canned tuna shipped from the West Coast to various points in the United States, during the last three years. About 75 percent of these shipments were via railroad; approximately 13 percent via truck; and around 12 percent by boat. Most of the light-meat, solid pack canned tuna handled by boat was shipped to the Atlantic coast for destinations in the Northeastern region with a small part of those shipments destined for Southern cities. Of that moved via railroad, at least 30 percent was shipped to the North Central United States. A considerable amount was also moved by railroad into the Northeastern region. It also was the predominant carrier used for shipments to the South but the total volume shipped to that area is small compared to the other areas of the United States. Tuna shipped in the West Coast area was shipped predominantly via truck.

The greatest percentage of shipments was moved via railroad for several reasons. Most canned tuna shipments are long hauls.

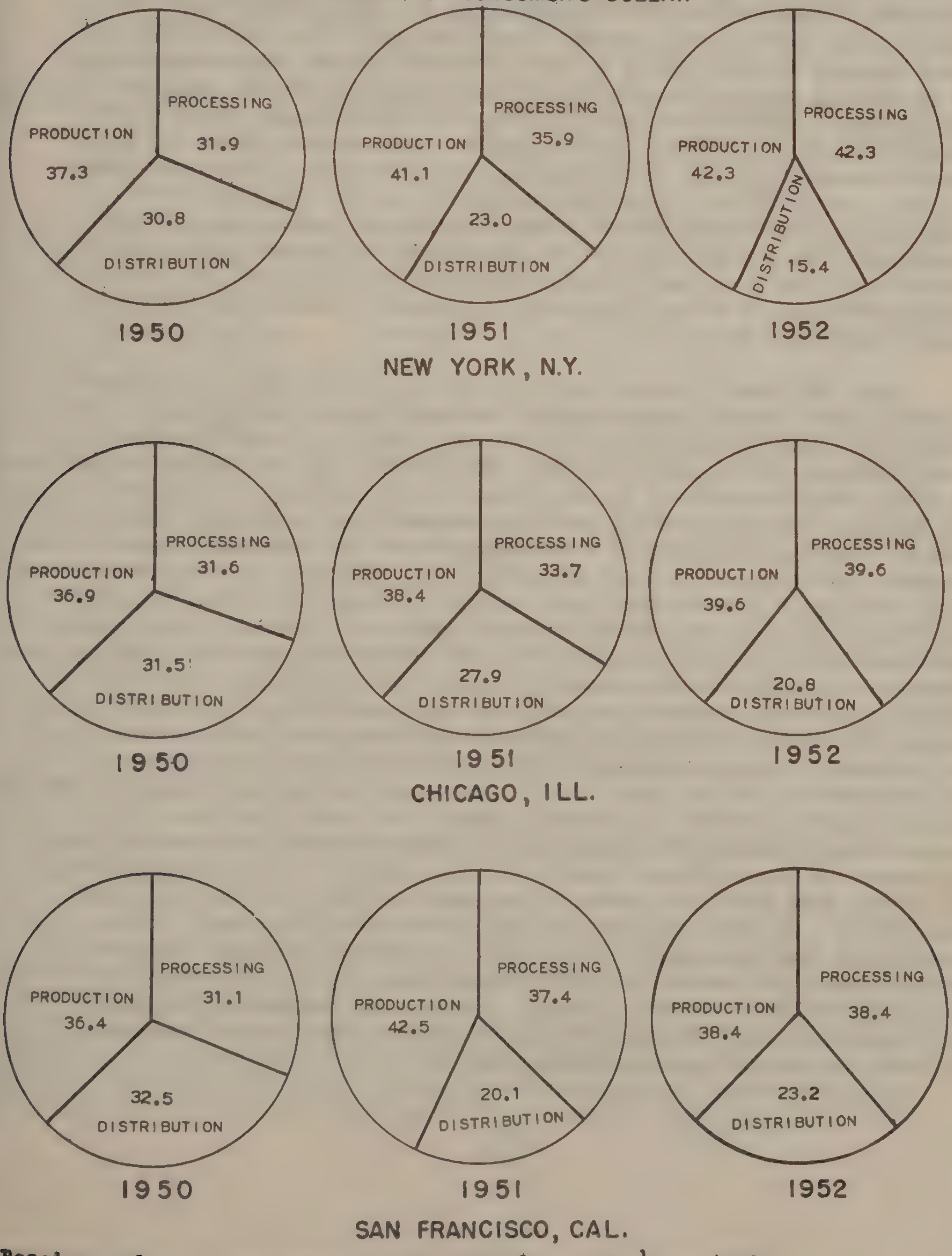
[23] Exclusive of local cartage and delivery.

[24] Includes a relatively small amount packed in Hawaii.

Figure 16

PRODUCTION, PROCESSING AND DISTRIBUTION SHARES OF CONSUMER'S* DOLLAR FOR WEST COAST CANNED TUNA 1/ SOLD IN SELECTED CITIES, 1950 — 1952

* PERCENT OF CONSUMER'S DOLLAR



Based on sales of light-meat, solid-pack, fancy, No.½ can tuna
ta from table 80

Railroad rates for canned tuna are favorable for a considerable part of the long-haul business when compared with rates of other types of transport. The favorable railroad rates for the general category of canned fish, under which canned tuna is shipped, may also be attributed in part to the nature of the product. Canned fish can be loaded in freight cars to a relatively heavy weight compared to many other foods. The use of heavy loadings also increases the economic utilization of transportation equipment. The sturdy nature of well-packed canned fish has also resulted in a low rate of loss and damage claims. In addition, favorable schedules and the fact that most plant locations have railroad siding facilities and access to railroads aids the movement of canned tuna by this form of transport. It should be noted that many of the foregoing factors apply in somewhat similar fashion to canned tuna when shipped by other forms of transport, especially boat.

Table 82 gives a comparison of railroad rates for various food products with canned fish shipped from Los Angeles, California, (Terminal Island, California) to Chicago, Illinois, and Pittsburgh, Pennsylvania. It illustrates more effectively the economical manner in which the transport of canned tuna by railroad can be conducted. The minimum weight commonly used for canned fish is considerably higher than the minimum for other foods shown in table 82, which supports the contention that canned fishery products can be moved from location of processing to consumption areas, as efficiently as other foods, if not, in many cases, more efficiently. The indicated railroad rates for canned fish are definitely more reasonable than for the other food products in table 82 reflecting this efficiency. For most commodities, in the table where a 15 percent increase of rates in 1952 as compared to 1950 is shown, an increase to that extent was authorized by the Interstate Commerce Commission and was made effective May 2,1952. Whereas, the rates for most of the commodities were increased 15 percent, those for canned fish were increased less because the Interstate Commerce Commission ordered that increases in the railroad rates for most canned foods be limited to an amount less than the general increase in freight rates which was authorized. In both cases shown the percentage increase in rates for canned fish amounted to 8 percent. Although railroad charges for shipments of canned tuna have been rising in recent years they have not been rising at as great a rate as the railroad charges for many other commodities,principally because of "hold-downs" ordered by the Interstate Commerce Commission.

TABLE 82.- RAILROAD RATES FOR VARIOUS FOOD PRODUCTS, INCLUDING CANNED FISH, SHIPPED FROM LOS ANGELES, CALIFORNIA TO CHICAGO, ILLINOIS AND PITTSBURGH, PENNSYLVANIA

(Carload rates per 100 pounds)

PRODUCT	ORIGIN	DESTINATION	DOMESTIC RATE 1/		PERCENTAGE CHANGE FROM 1950 TO 1952		MINIMUM WEIGHT
			Effective 1/1/50 Dollars	Effective 5/2/52 Dollars	%	Dollars	Pounds
Canned fish.	Los Angeles 2/	Chicago	1.50	1.62	8.0	0.12	60,000
Eggs, in shell...	Los Angeles	Chicago	3.10	3.57	15.0	0.47	33,000
Frozen fish.	Los Angeles	Chicago	1.75	2.01	15.0	0.26	36,000
Fresh citrus fruit, oranges...	Los Angeles	Chicago	1.73	1.85	6.9	0.12	39,200
Cheese......	Los Angeles	Chicago	3.32	3.82	15.0	0.50	24,000
Canned fish.	Los Angeles 2/	Pittsburgh	1.50	1.62	8.0	0.12	77,000
Eggs, in shell..	Los Angeles	Pittsburgh	3.10	3.57	15.0	0.47	33,000
Frozen fish.	Los Angeles	Pittsburgh	2.48	2.85	15.0	0.37	36,000
Fresh citrus fruit, oranges...	Los Angeles	Pittsburgh	1.73	1.85	6.9	0.12	39,200
Cheese......	Los Angeles	Pittsburgh	3.67	4.22	15.0	0.55	30,000

/ Rates are approximately correct. Percentage increases authorized and effected have been calculated herein on base rates whereas under ordinary circumstances these percentage increases are applied to the total base transportation charge.

/ Applicable to cars loaded at Terminal Island, California and other West Coast points.

Canned tuna shipments moved via truck were concentrated in the West oast Area close to the source of supply. One of the distinct charactertstics of truck transportation within a limited area is the ability of hat type carrier to adapt better to stop-offs enroute for partial unoadings. This creates a higher quality of service on short hauls which s often offered at favorable rates. Motor carriers' speed of delivery nd lower carload minimum also gives them competitive advantages over the railroads for certain types of short haul. Nearly all truck shipments of canned fish from Terminal Island, California, are made on a minimum of 30,000 pounds or an equivalent of around 1000 cases of canned tuna.

Most of the canned tuna shipped via truck is destined for San Francisco and Sacramento, California, Salt Lake City, Utah, Western Idaho, and Central Oregon. Movements of canned tuna to Portland, Oregon are usually made via railroad or by boat. Shippers indicate that boat rates are more favorable to Western Oregon than are truck freight rates. Shipments of canned tuna to Denver, Colorado, are usually made by railroad instead of motor carrier since railroads have comparable rates and terminal connections from the West Coast Area to that city.

The majority of canned tuna shipments via inter-coastal boats were to the Northeastern United States. A small amount was shipped to South Atlantic ports. Rates lower than those via railroad and low carload minimum requirements are maintained to Atlantic seaboard points. These low cost factors of boat transportation are important to many packers of canned tuna, especially smaller ones, and buyers. Smaller concerns not packing in quantities that would allow them to take advantage of the higher railroad minimum carloads can utilize boats and obtain carload rates for shipments as low as 20,000 pounds.

Available data indicate that there was a slight increase in the shipments of canned tuna via inter-coastal boat in 1952 as compared with 1950. It also shows that approximately one and one-half percent of light-meat, solid pack, canned tuna shipped by those West Coast companies which furnished transportation information in this survey was destined for South Atlantic ports. The outstanding disadvantage of boat transportation presently is the slow delivery time.

If it is considered that the transportation function is a necessary service which must be utilized to place canned tuna in the consumer's hands, and if the particular advantages or disadvantages of one form over the other are disregarded there are certain generalizations that can be made regarding canned tuna shipments. Practically all forms of rates for this commodity are regulated and the great bulk of it is shipped under commodity rates. Commodity rates are previously published in tariff form, as required by the Interstate Commerce Commission, and other regulatory bodies. From the west coast to various Eastern areas there is usually designated a blanket charge which is the same for any point of origin in the particular area covered. Changes in these published commodity rates are made usually only after adequate hearings and study. Assuming that all west coast tuna canners were surrounded by equal production conditions little saving in the cost of transporting their products could be realized under present rate-making procedure. The fact that production conditions in this area are not equal accounts for much of the difference in the cost of placing canned tuna in the consumer's hands at a particular place rather than differences in shipping charges. It must also be realized that there are regional differences in shipping charges on canned tuna produced in other regions. However, it has been noted that such production is relatively small at the present time.

Table 83 illustrates the relationship of transportation rates to the average retail price of the solid-pack, light-meat, fancy No.1/2 can of tuna. The table shows the cents per case value and the percentage of the retail price that is obtained by various transportation agencies for selected types of movements. In general, transportation rates ranged between a low of .5 percent of the retail price for canned tuna when shipped via truck, from Terminal Island, California to San Francisco, California; to a high of 3.22 percent of the retail price when shipped via railroad, from Terminal Island, California, to Boston, Massachusetts. In no case, was there an increase in 1952 over 1950 greater than .6 percent of retail price, regardless of the type carrier rates used for comparison. Railroad transportation rates in 1950, from the Pacific coast to the cities named did not exceed 3 percent of the retail price and in several instances averaged closer to 2 percent. On a cents per case basis the charges averaged approximately 44 cents or less than one cent per No.1/2 can on a 48-can standard case basis. By 1952 the railroad rates, as a percentage of the average indicated 1952 canned tuna retail price had increased a maximum of only .6 percent to New York, New York, and a minimum of .33 percent to Atlanta, Georgia. All these railroad increases amount to about 3.3 cents on a per case basis because practically all railroad rates were increased the same maximum amount 12 cents per hundred weight.

For inter-coastal boat charges from Pacific coast ports, only the Northeastern Atlantic ports of Boston, Massachusetts, and New York, New York, are indicated in table 83 since the greatest part of all canned tuna shipped via boat is destined there. Inter-coastal

TABLE 83. - SELECTED PRIMARY TRANSPORTATION CHARGES FOR SHIPPING SOLID PACK, LIGHT-MEAT, FANCY NO. 1/2's OF CANNED TUNA AND RELATION TO RETAIL PRICE, 1950-1952. 1/

TYPE OF SHIPMENT	ORIGIN	DESTINATION	YEAR	SHIPPING CHARGE		AVERAGE RETAIL PRICE PAID BY CONSUMERS	
				CENTS PER CASE	% OF RETAIL	DOLLARS PER CASE	CENTS PER CAN
CARLOAD RAILROAD FREIGHT	WEST COAST	BOSTON, MASS.	1950	47.5	2.83	16.75	34.9
			1951	48.2	2.69	17.90	37.3
			1952	50.8	3.22	15.74	32.8
	WEST COAST	NEW YORK, N.Y.	1950	47.5	2.44	19.44	40.5 2/
			1951	48.2	2.71	17.76	37.0
			1952	50.8	2.99	16.94	35.3
	WEST COAST	WASHINGTON, D.C.	1950	47.5	2.36	20.11	41.9 3/
			1951	48.2	2.65	18.14	37.8
			1952	50.8	2.70	18.76	39.1
	WEST COAST	ATLANTA, GA.	1950	40.9	2.08	19.63	40.9 2/
			1951	41.6	2.31	18.00	37.5
			1952	44.2	2.41	18.28	38.1
	WEST COAST	DALLAS 4/ and HOUSTON, TEX.	1950	39.0	1.83	21.21	44.2
			1951	39.7	2.32	17.08	35.6
			1952	42.3	2.25	18.72	39.0 3/
	WEST COAST	CHICAGO, ILL.	1950	40.9	2.08	19.58	40.8 3/
			1951	41.6	2.18	19.00	39.6
			1952	44.2	2.44	18.09	37.7 3/
INTER-COASTAL BOAT (Carloads)	WEST COAST	BOSTON, MASS.	1950	35.7	2.13	16.75	34.9
			1951	35.7	1.99	17.90	37.3
			1952	41.1	2.61	15.74	32.8
	WEST COAST	NEW YORK, N.Y.	1950	35.7	1.83	19.44	40.5 2/
			1951	35.7	2.01	17.76	37.0
			1952	41.1	2.43	16.94	35.3
TRUCKLOAD SHIPMENTS-BY WEST CST PROC-ESSORS	TERMINAL ISLAND, CAL.	SAN FRANCISCO, CAL.	1950	10.6	0.5	19.92	41.5 2/
			1951	10.6	0.6	17.14	35.7
			1952	11.6	0.6	18.67	38.9
TRUCKLOAD SHIPMT BY EAST COAST PROCESSORS	EAST 5/ COAST	NEW YORK N.Y.	1950	23.9	1.22	19.44	40.5 2/
			1951	23.6	1.32	17.76	37.0
			1952	24.6	1.45	16.94	35.3

1/Estimated average charge per standard case of 48 cans. 2/Apr-Dec (9 mo.) 3/February-December (11 months). 4/Dallas, Texas for 1950 and Houston, Tex for 1951 and 1952. 5/Average origin for the area.

SOURCE: Compiled by the United States Fish and Wildlife Service.

boat charges were approximately 2 percent of the retail price for canned tuna in 1950, and by 1952 they had increased to only about 2-1/2 percent of the retail price. Therefore, in 1950 it cost about 32.7 cents per case to ship canned tuna to these areas, and in 1952 about 41.1 cents per case.

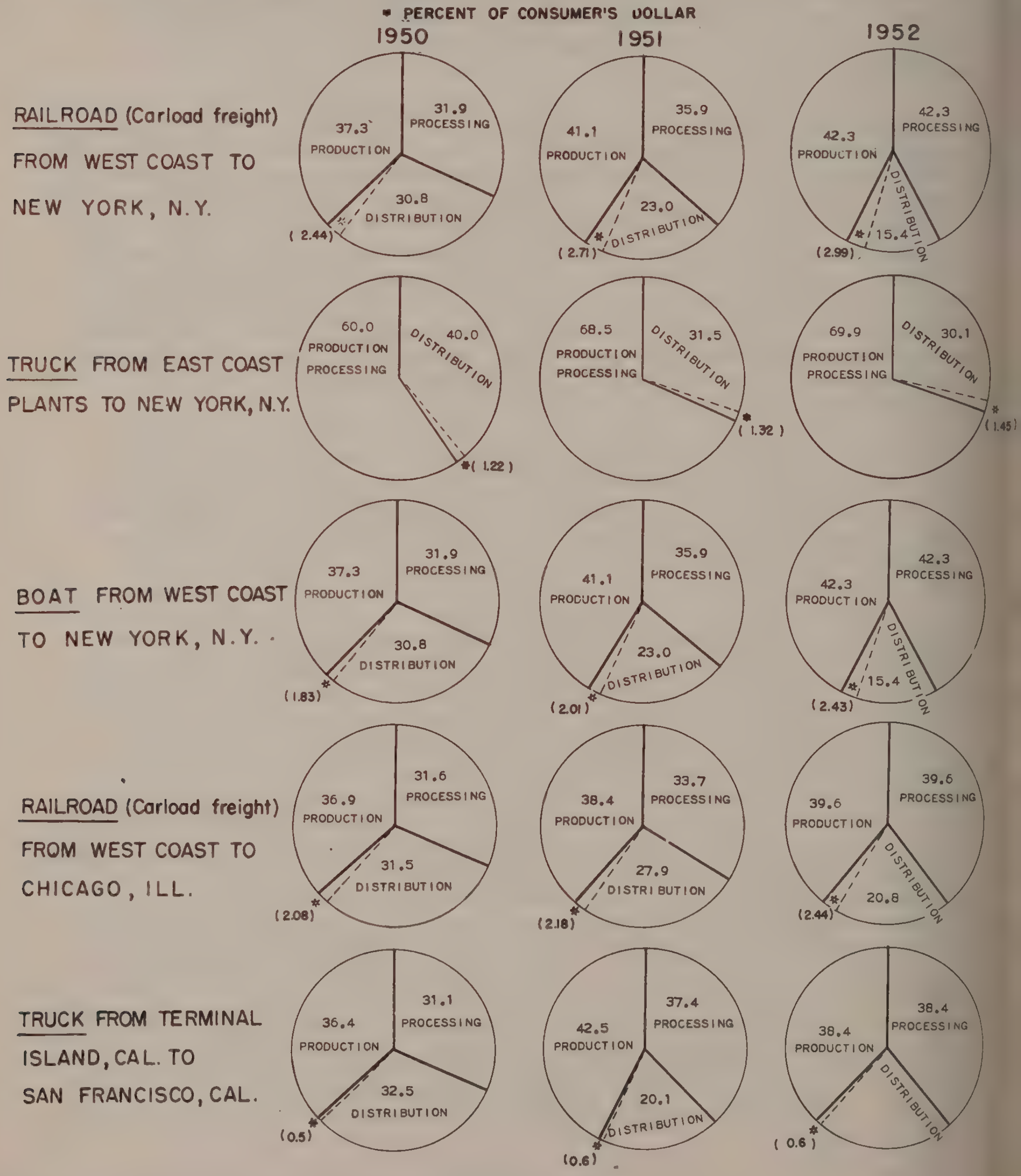
Truck transportation charges from Terminal Island, California to San Francisco, California are shown for canned tuna packed on the West Coast. Since the majority of canned tuna is now packed in the Terminal Island, California area, and San Francisco, is a large consumer area, comparison of truck rates to retail prices for that city was made. West Coast packers have indicated that the majority of canned tuna moved on the West Coast is by motor carrier. Truck rates in 1950, from Terminal Island to San Francisco were approximately .5 percent of the indicated retail price for canned tuna. There has been only a slight percentage increase of .1 percent through the year ending 1952, with a 9 percent intra-state rate increase being authorized by the California Public Utility Commission, June 24,1952.

For canned tuna packed on the east coast average truck transportation rates to New York City are shown. East coast packers indicate that New York City is an important market for their tuna products and much is transported there via truck. Truck rates for the average haul to New York City from east coast plants are only 1.45 percent of the retail price in the year when the highest average rate prevailed-1952.

The small percentages of the consumer's payment for canned tuna taken by primary transportation agencies shown in table 83 and again graphically in figure 17 for certain selected transportation movements, do not materially affect the retail prices paid by the consumer. At 48 No.1/2 cans to the standard case the charge for the long haul railroad movements is about one cent per can and for the boat, truck and shorter haul railroad movements it is less than one cent per can. Most transportation charges are subject to review and corrective action by public regulatory bodies. Charges for canned food products have been subjected to considerable review by these bodies. As a result of this action, they may be considered to be reasonable and it is extremely unlikely that any significant reductions or savings could be made in this field which would reduce over-all marketing charges for canned tuna.

Figure 17

PRODUCTION, PROCESSING, DISTRIBUTION AND PRIMARY TRANSPORTATION AGENCY SHARES OF CONSUMER'S* DOLLAR FOR CANNED TUNA[1/] TRANSPORTED BY VARIOUS METHODS TO SELECTED CITIES, 1950 — 1952.



[1/] Based on sales of light-meat, solid-pack, fancy No.1/2 can tuna.
Figures in parenthesis are primary transportation.
Data from tables 80, 81 and 83.

U. S. FISH AND WILDLIFE SERVICE

STORAGE

Nation-wide storage facilities for canned tuna are adequate according to available information furnished by the Office of Price Stabilization in December 1952. There does not appear to be any problem on the part of wholesale grocers and other large lot receivers, that handle canned tuna, in providing storage space for their purchases. The tuna packers, who store canned tuna in various centers of distribution so as to have stocks available for quick delivery, have voiced no complaint with respect to storage space shortages.

Storage charges in commercial warehouses were ranging from 5 to 7 cents per hundredweight in December, 1952, equaling approximately 1-1/2 cents per case of canned tuna stored for a one month period. This is but a small fraction of the retail price of canned tuna. Since top Office of Price Stabilization ceilings were being charged pretty much over the entire country the question could be raised as to whether storage charges are "reasonable". Certainly, from the standpoint of the owners of the storage facilities the ceilings are too low, and therefore, charges are "unreasonable", and from the standpoint of those who pay the storage costs they are either "reasonable" as they exist or "unreasonably" high. In other words, the "reasonableness" of storage costs depends on who is doing the estimating.

It would appear, from a consumer standpoint that so long as storage costs are as indicated a very small fraction of the retail price per can of tuna and the storage function is being handled expeditiously, then the storage charges are "reasonable". Certainly storage costs like primary transportation costs do not act to significantly increase the consumer price for canned tuna.

Marketing

WHOLESALING AND RETAILING

After the transportation agency brings canned tuna from the processor's plant to the buyer's warehouse, a public warehouse, or other delivery point, the wholesaler or large lot receiver next physically handles the product and next after him the retailer. The wholesaler or chain store warehouse department's main function is to bear the risk involved in having large quantities of canned tuna available for quick delivery to retail stores and other outlets. The wholesaler may buy large lots of a thousand or more cases and dispose of them in small lots so that the retailer, for example, can handle such a small lot of canned tuna as a few cases, a case, or half case, along with the many other items he must have available for the needs of his customers. The services of retailing take the largest segment of the distribution payment from the consumer's dollar. Wholesaling takes the next largest segment. In this study consideration was given to reviewing these marketing practices to see if anything could be done to improve the physical handling of canned tuna and thus reduce wholesaling and retailing costs and margins.

Wholesale marketing procedures are being improved with many new methods being initiated by leading wholesale grocers and chain store system operators. These new methods have focused on adjustments in merchandising policies and physical operation. Most improvements in this field, however, have but a small effect on reducing total distribution costs and are not as revolutionary as self-service super market retailing was in the retail field.

Wholesalers and chain stores have improved efficiency and cut the costs of operation by reducing the cost of taking sales orders. This cost can be minimized by reducing effort expended by salesmen or order men, increasing the average order size, and eliminating unprofitable orders. Methods of assembling orders within the warehouse have been revised. Merchandise is arranged in systematic sections so that order men know where each item is situated. Reserve stocks are separated from assembly selection lines. The latter are arranged in order of turnover with items sold most frequently nearest the order assembly area. Separate arrangements are provided to handle special orders, such as split case lots. All operations are integrated so that job timing will be most efficient with respect to use of plant and workers.

Wholesalers have tried to reduce their delivery costs by fostering closer working relations with the retailers and thus reduce the number of deliveries. Constant effort has been exerted toward reduction of time spent in loading and unloading trucks, both at the retailer's platform and the warehouse. Those retailers who place late orders are often penalized by being placed on a cash-and-carry basis. Truck routing has been improved and common carriers are being utilized where the charge is less than the cost of operating a wholesaler's truck. The latter practice is also common among other large lot receivers such as chain stores.

Some less direct procedures for minimizing costs have been initiated such as preventive maintenance on owned trucks, loading trucks as full as possible and arranging for return hauls, and the use of driver logs or mechanical recorders to effect greater regulation over trucks which are enroute.

The degree to which wholesale grocers and chain stores can apply all or some of the above methods of improvement in physical operations depends upon the unique circumstances surrounding each individual business. Some warehouses are located in areas where there is traffic congestion and generally poor facilities for operation of large trucks. Older warehouses are not readily adaptable to new methods of order assembling. Innumerable physical as well as economic problems, confront established wholesale grocers and chain stores when innovations are required by changing times. Generally speaking, wholesale marketing is a very competitive field and by the fact that this competition exists it can be assumed that those who do not function efficiently will be forced either to revise their methods of operation or go out of business.

Wholesale grocers and chain stores purchase the great bulk of the domestic pack of canned tuna from processors. These purchases are stored in the respective warehouses of each buyer. The bulk of the cases of canned tuna purchased are stored in that section of the warehouse assigned to reserve canned commodities. When additional canned tuna is needed in the order assembling area it is brought forward from the reserve sources, and placed in selection lines according to its bulk and prospective turnover. Canned tuna and tunalike products are handled in an identical manner to hundreds of other canned commodities sold by wholesalers or distributed from chain store warehouses. Therefore, any improvement in the overall physical operation of warehousing will in some degree improve the marketing of canned tuna and tunalike products. The many other improvements in the over-all job of wholesaling which have been previously mentioned are also tending to aid the marketing of the products of the tuna industry.

Retail grocers' marketing procedures have undergone many physical changes within a relatively short period of years. The change from the small service grocery store on the corner to the hugh super market type grocery that occupies perhaps an entire city block and uses self-service methods has forced revolutionary improvements in retail marketing procedure. It has also been instrumental in making sizable cuts in the cost of retailing.

The keen competition existing between retailers has resulted in a persistent demand for the activation of more detailed merchandising research. Studies have been directed toward improving retail methods of physical operation such as receiving, check in, price marking, and stocking groceries. Each of these functions have been analyzed through time and motion studies, and improvements have been developed through more efficient handling methods and equipment, and the proper choice for store layout. All this physical handling is a part of the most important item in the total cost of retailing--labor. Wages are the biggest part of the margin exacted for both retailing and wholesaling and therefore, efforts to make the wisest and most efficient use of labor are not directed aimlessly.

Wholesale and retail margins on canned tuna are tied into the many other things sold by these distributors. The essential problem of wholesaling and retailing is not one that can be resolved in terms of any one particular product. The general problem confronting both wholesaler and retailer is the movement of numerous products and not just the specific handling of canned tuna. However, in tackling this general problem many specific determinations are made as to how different items are to be handled and these specific determinations vary considerably one from the other. The percentage margin on a staple volume item or a high priced item may be low, whereas the margin on a perishable or a low priced item may be high. A brief discussion of Federal price regulations as they have concerned wholesale and retail grocers should establish some basis for a review of the margins for canned tuna to see if they are reasonable, particularly since regulations on canned tuna and tunalike products have been in effect nearly six of the last ten years.

During the greater part of World War II, wholesalers and retailers of canned foods were required to establish ceiling prices for merchandise which they sold. At the end of the war in 1945 and for the greater part of 1946, individual wholesalers were required to determine into what category their particular kind of operation fell, along with the classification of merchandise handled. By reference to a table supplied by the Office of Price Administration (O.P.A.), which showed the different categories, a set of mark-up factors could be ascertained. These mark-up factors were then multiplied by the particular wholesaler's "net cost" and the product equalled the maximum or ceiling price that could be charged. Similarly, retailers were classed in certain categories according to their volume of sales. Four groups were established and for each group a maximum percentage mark-up by commodity class was specified. A retailer could determine his maximum allowable mark-up for most any commodity simply by reference to the proper table issued in Office of Price Administration regulations.

Until recently when ceiling prices on all canned foods were dispensed with the Office of Price Stabilization (O.P.S.), procedure was the same as that required under O.P.A. for obtaining wholesale ceiling prices. The retailer's procedure was also the same as under O.P.A. except that the value limits of each of the four group classifications based on volume of sales was increased. This was probably brought about by the increased growth of independent super market and chain store type merchandising and higher prices with resultant higher sales volumes.

Under O.P.S.regulations the maximum permissible retail mark-ups applying to canned tuna, ranged from 21 to 25 percent of the retailer's purchase price. Seldom was the full 25 percent mark-up applied to canned tuna at the retail level. In many instances the margins of retailers were far below those permissible. This indicates that competition in retailing canned tuna is effective and the margins on that product are probably reasonable. An example of the relatively low margins for canned tuna is given in a comprehensive study of seven super markets, located in Providence, Rhode Island published in 1952 . This study was made during 12 weeks in October, November and December, 1950. The gross profit margin as a percent of sales for canned tuna was 13.30 percent. If the margin is computed as a mark-up on the basis of cost, as was the practice under O.P.S.regulations, the result is somewhat higher--15.34 percent. This mark-up of 15.34 percent, based on cost was lower than any allowable mark-up on canned fish for retail stores put into effect by the Office of Price Stabilization immediately after this study. Since this particular case study covered only a 12-week period in a specific area, the results could hardly be used as an indicator of national retail margins for canned tuna. The results do show that efficient retail outlets do and can charge quite low mark-ups for canned tuna and reports indicate that this is prevalent and not exceptional over the nation..

The study also demonstrates that individual margins are not a reliable measure of whether a particular commodity is being handled profitably or efficiently. All individual margins must be related to an over-all selling policy. Low margins and, therefore, relatively low prices are charged on many items so that customers can be attracted and thus increase sales. Other reasons can contribute to maintaining low margins on some items. At the same time, margins on other items will be relatively high. This is illustrated in the study of the Progressive Grocer. The margin on sales for all canned fish was 15.99 percent. Whereas canned tuna was being sold at a lower margin (13.30 percent), canned sardines were being sold at a margin of 26.57 percent of sales and the canned herring margin was 27.71 percent. Canned tuna is a fast moving and volume item, accounting for 41 percent of the value of all sales of canned fish covered in this study. Sardines accounted for only 9 percent of the value of all sales of canned fish covered. These facts tell part of the study as to why various canned fish items are handled differently with respect to retail margins. The right combination of both high and low margins, so as to result in high sales and a competitive margin on total sales, is the primary objective of large retail outlets. In the determinations of margins retailers appear to have kept those on canned tuna relatively low.

In the merchandising of canned tuna and tunalike fish products on wholesale and retail levels, as discussed earlier, progress is being made and as new improved developments occur adjustments are being made. Wholesalers and retailers are constantly working toward the attainment of a position where they can utilize the most efficient methods of physical operations in conjunction with a realistic selling policy so as to maximize their profits. The outlook is for continued progress to be made in developing better methods of wholesaling and retailing in general and for canned tuna and tunalike products in particular. However, it is likely that each improvement will have only a relatively small influence on the total margin taken by those agencies of distribution unless a revolutionary development like super market self-service retailing should again occur. Since canned tuna is a volume item among canned fish it is likely to be handled with a favorable level of margins being set by wholesalers and retailers for this item as compared to many other canned fish items.

BROKERS AND SALES PRACTICES

The physical handling of canned tuna and tunalike products has been traced from the time the processor is finished with them until the consumer buys them. In the discussion of that handling, it was pointed out that the primary transportation agency is the processor's first contact with the distribution system where his product is physically handled by a distribution agency. Even before this contact is made, however, there is usually an earlier personal contact between the processor and a selling agent in the distribution system who may be either a broker or a representative of a chain store organization, or grocer, or some other large lot handler. Usually it is the broker with whom a contact is first made.

The broker is an expert in the marketing of canned tuna and tunalike products, who knows a great deal about the desires of consumers for those products, the quality of the products of various packers, transportation problems, etc. Brokers maintain contacts with large lot buyers and through them processors can easily find buyers for their products. Brokers do the work of making contacts to see who wants canned tuna and tunalike products and then consolidate the various needs indicated to them into the form of orders given to their principals, the processors. They are compensated individually for such selling efforts with a remuneration of a certain percentage of the value of the sales they make being paid to them by their principal.

In 1951 approximately 90 percent of all domestic canned tuna and tunalike products was packed in California. Of that 90 percent slightly over 70 percent was packed by three large fish canning companies. The methods used in marketing canned tuna by these companies and others should give a good representation of the general procedures followed. The information contained in the following paragraphs is assembled to reveal marketing methods of the tuna packers, presently in use, so that a more dynamic knowledge of the tuna processor's problems with respect to dealing with marketing agencies can be acquired.

The greatest percentage of the canned tuna pack is sold through food brokers. Most of the balance is sold direct to buyers through packers' regional and home offices or through sales agents. Food brokers do not take title to the commodities they handle, but usually act as an intermediary between processor and buyer. Firms that establish regional sales offices do not as a rule dispense with brokers in the territory covered by the regional office. The regional office is concerned more with supervising the actual physical distribution and sales promotion of the firm's pack.

There are several types of wholesale distributors and/or organizations performing like services that handle the wholesale marketing of the canned pack. These include retail-owned cooperatives, independent wholesalers, chain store warehouses, and warehousing units of other large retailers. The quantities of canned tuna or tunalike fishes sold to each type of wholesale distributor vary according to their anticipated volume of sales. The volume of products of the tuna industry sold to chain store warehouses has increased in the post-World War II period, according to available estimates from firms who pack those products.

Most firms market their products on a cash basis allowing a discount if bills are paid within a limited number of days after the date of the invoice, usually 10 to 30 days. The discount is usually 1-1/2 percent of the invoice value.

Brokers are paid a 3 percent commission based on the face value of the invoice, and there is generally no limit on volume they can handle.

Brokers do not conduct advertising for the companies as a rule, but are requested to lend full brokerage services such as contacting wholesalers, chain stores, and other retail outlets. The number of individual brokerage firms that handle an individual processor's pack varies from two or three per firm up to as many as one hundred for a single large firm, each with a separate territory to cover.

The larger packers have their own name brands and carry on their own sales promotion campaigns. Individual tuna processing corporations have been known to spend as much as one million dollars or more a year for direct advertising purposes. In addition, these same firms and others engage in cooperative advertising agreements that stipulate a certain sum will be paid per case, to the buyer, upon receipt by the packer of evidence that the buyer has advertised the packer's "brand". Advertising usually consists of space purchased in local newspapers. The sum generally allowed per case is 50 cents. Agreements of this nature represent a considerable cost when the amount paid per case is multiplied by the total number sold. Packers are not always enthusiastic concerning cooperative advertising agreements. In some instances the agreements are construed to be effective price cuts and are highly desirable to buyers. Consequently, advertising agreements tend to become a "business custom" and, therefore, are demanded by prospective purchasers of canned tuna.

In contrast to the larger packers operating nationally, many of the smaller packers sell their entire pack to large retail outlets who in turn label the cans with their own "private" brand names. Large chain stores have private labels and also sell national name brand products. Other small packers may use their own "brand" name on a private label, selling the majority of their pack in certain localities. These brands are sold by anyone who wishes to handle them within a limited area.

The canned pack is distributed in various ways usually determined by the size of the processing firm. The large firms hold a certain percentage of their current inventories directly adjacent to their plants with the balance of the inventories being warehoused at various distribution centers throughout the nation. Smaller packers ordinarily retain the majority of their canned tuna in warehouses located at the plant site. So far as it can be ascertained, the processing firms do not own or control warehouses in any of the cities of the country where distribution is made.

The level of inventories at the various centers of distribution are based on projected sales figures or anticipated turnover. The storage charges associated with tuna stored for the account of the processor at the different distribution points are absorbed by the processor. The necessity to keep canned tuna available in rather large quantities at points other than plant site has developed, in part, from the increasing growth of chain stores and super market type distribution. These kinds of retail outlets operate on volume turnover accompanied by a short time interval between purchase and resale. Large orders are placed and expected to be filled momentarily. Brokers must be able to guarantee immediate delivery or buyers turn to a source that can meet their needs. The competitive marketing conditions of the canned tuna industry have forced the processors to accept the burden of the cost of maintaining this immediate source of supply.

Prices charged by processors are F.O.B. shipping point which is usually the cannery. Transportation charges are paid by the canners who are compensated by adding freight costs to invoices sent the buyers. Tuna canning requires a large cash outlay for purchase of raw fish and processing with no return being realized until after the pack is sold and in the hands of the buyer. This process may take from 2 to 3 months or more. The seasonality of the raw fish supply requires that inventories be held for extended lengths of time through periods of light fish deliveries if the processor intends to stabilize a year-round market for his brand. These marketing conditions give rise to various problems of finance.

Financing through loans is undertaken to carry inventory. In general these loans are considered a high type and there has been no great difficulty with this type of financing in the industry. Some further information with respect to recent Reconstruction Finance Corporation experience in the domestic tuna industry is given in Chapter VII.

In pricing their product for sale it has become a common practice among processors of canned tuna and tunalike products to "guarantee floor stocks". Floor stock guarantees mean that the packers of tuna advise their brokers that the prices of certain kinds of canned tuna or tunalike products held by buyers will be guaranteed against the packers own reduction in prices. This applies to the buyer's warehouse floor stocks, goods in transit, and unshipped orders. Most of the firms limit this guarantee to about sixty days.

This guarantee allows the brokers to quote a specific price to buyers without the associated risk of a price decline from the processor level occurring shortly after the buyer pays for and gets his order. The arrangement establishes good processor-buyer relations, and to some extent, assures the processor of a future buyer. Guarantees should tend to reduce the processors' inventories since the buyers can purchase greater quantities without the risk of a packer price cut.

Brokers and wholesalers consider guarantees desirable since risk of canners' reduction in price is removed. However, from a packers standpoint certain difficulties could arise. For instance, if some phase of the production of raw material costs were reduced, and the packers wished to cut their prices, so that buyers could take advantage of the lower price and enlarge markets, they would be penalized to the extent of their existing guarantees. Generally speaking, the processors are opposed to floor stock guarantees; they are a problem for them; but the guarantees have become a policy of the industry and are virtually required to be extended in order to sell canned tuna expeditiously.

Floor stock guarantees are "insurance" — price change insurance— for distributors of canned tuna and tunalike products. They tend to stabilize prices to some extent. Anything that helps to stabilize prices tends to stabilize physical movement and thus lead to lower unit cost of operation.

On the whole, the tuna packers' present methods, as described in the material above, for marketing their canned pack are efficient and are reasonable in cost. With the competition that exists in the marketing of canned tuna and tunalike products efficient methods must be utilized, by the firms within the market. Those firms that are not efficiently operated must sooner or later cease operations.

It follows, then, that since the tuna processors are operating within a competitive market structure[25] each must meet the requirements that generally prevail in that structure, and are being practiced, by those who compete for the sale of canned tuna and tunalike products. No individual firm within the present canned tuna market can reduce its brokerage commission, disallow "stock guarantees", or drastically reduce its expenditures for advertising and promotion of its products, and still hope to maintain its position in the market. Marketing customs which have been established on an industry-wide basis tend to become "industry institutions" and therefore, become a part of doing business. Most reputable concerns will not forsake established business institutions for short-run, dubious innovations.

The general information contained in the above discussion of the methods utilized by canned tuna processors to distribute their pack indicates that they are doing as good a job as competing canned fish processors. There is also enough evidence to show that distribution and marketing costs are no higher for canned tuna than for other canned fishery products. Some discussion on the over-all aspects of that subject was undertaken in the previous section. As an example of a specific item of distribution cost, the brokerage fee is 3 percent of invoice for established brands of canned salmon, as well as canned sardines--the same as for tuna. It must be kept in mind that brokerage commissions on fishery products vary according to the manufacturers or processors who pay them, rather than according to the kind of fishery product offered on the market. Generally speaking, commission fees may be higher than 3 percent of invoice if the product offered for sale is not too well established on the market, and greater effort is required on the part of the broker to merchandise it. Brokerage commissions are generally higher than customary if the product is not regularly processed by a particular firm and is being handled only as a product for off season processing. In short, brokerage commission fees will vary slightly according to the anticipated dollar return from the product being handled. Canned tuna has become a rather basic item in the trade and is handled with reasonable charges.

25/ The exact degree of the competitive nature of the market structure was not determined in this study.

Industry Statistics

PRODUCTION STATISTICS

At present, the data on the receipts of tuna at California canneries as well as the pack by these canners are available on a monthly basis from the California Department of Fish and Game. These data and information on landings and imports in California are also published weekly in the Market News reports issued by the Fish and Wildlife Service at San Pedro. In the past, these data have been sufficient for the industry as only a small pack of tuna was produced outside of that State. With the increased interest in packing tuna in other areas, it is necessary to consider imports and packs in other sections. The California tuna industry has recently requested that the Service obtain data on imports of fresh and frozen tuna in other Pacific Coast Areas and published them in the San Pedro Market News reports. If the expansion of tuna canning on the Atlantic coast continues, similar information for that area would also be necessary in estimating total supplies available.

Somewhat similar data are available on the pack of canned salmon-a closely competitive product. Information on the pack of salmon in Alaska is available weekly in the Market News reports issued by the Fish and Wildlife Service at Seattle during the packing season. Data on the Puget Sound production are issued at intervals by the Washington Department of Fisheries, and published in the Seattle Market News reports also. There are no regularly published figures on the salmon pack in the Columbia River and Coastal districts, but the pack of these districts does not usually represent more than 5 percent of the total production.

Similar information for canned mackerel and canned pilchard are available on a monthly basis from the California Department of Fish and Game, although these products are not generally considered to be directly competitive with canned tuna.

Estimates of actual and anticipated production of fresh meat and poultry and canned poultry—which are competive with canned tuna in the sense that they are protein foods—are published monthly by the Department of Agriculture. Apparently very few persons interested in the marketing of canned tuna pay any attention to these items, but their supply and price undoubtedly affect the sales of canned tuna.

STOCK STATISTICS

While information on the quantity packed is of major importance to the producers and distributors of canned tuna, data on the stocks on hand at the packer and wholesaler levels would be of equal or possibly even more benefit. This type of information is probably of more direct importance to the buyer and seller of canned tuna than data on the total pack. Generally speaking, the wholesaler seems to be more interested in these data than the packer. However, the packer could use statistics on stocks to even greater advantage than could the wholesaler. Information of this type would show the canners when stocks were starting to pile up at the wholesale level. At present, these stocks can reach dangerously high levels before any intimation of marketing difficulties reaches the packer in the form of reduced or cancelled orders. It takes several months to slow down or stop canning operations due to the long trips made by the fishing vessels. Consequently, any information that would enable the packer to obtain earlier information on sales or stocks at the various levels of distribution would assist in preventing glutted markets.

The monthly holdings in cold storage warehouses of frozen meat, poultry, and fish are published by the Department of Agriculture and the Fish and Wildlife Service. The California Fish Canners Association collects data on stocks of canned tuna owned by its members. This information is not generally available except to Association members. However, public information is not available on stocks of canned fish of any variety.

When queried on the subject of statistical data, a number of brokers said that most of their information was obtained from their principals (canners). In addition to the information obtained from Fish and Wildlife Service reports, some brokers obtain some general information from such sources as trade magazines and reports of the American Institute of Food Distribution. The information available from the single packer represented by a broker is necessarily somewhat sketchy and in some cases is not indicative of the status of the entire industry. However, some brokers undoubtedly obtain the information on canned tuna stocks collected by the California Fish Canners Association from members of that Association.

CONSUMPTION DATA

Another type of information required for modern marketing consists of data on the regional consumption of the item. Some companies are able to work this out for their own brands, but brand distribution may not be indicative of total product consumption. This information helps in determining where money for advertising will get the maximum return. It also helps to appraise the results of advertising and to determine the type of sales promotion that does the most good.

Data are not available on regional consumption of any canned fishery products. Studies of the regional marketing of meat and poultry products are made at frequent intervals by the Department of Agriculture.

Periodic studies of the regional consumption of canned tuna would provide a basis for the orderly expansion of the market.

PRICE DATA

Vessel Landings

Considerable information with respect to prices for tuna and tunalike species at the ex-vessel level is available from the Fish and Wildlife Service, reports and trade publications.

Canned Tuna

Canned tuna prices(f.o.b.canner's terminal) are quoted weekly by the San Pedro Market News Service office. Quotations are obtained from brokers and cannery representatives in the San Pedro-Los Angeles area. Prices are quoted for advertised brands and for private labels.

Based on prices quoted by the San Pedro Market News Service office, once a week the United States Bureau of Labor Statistics is supplied with a quotation for light-meat, solid-pack tuna,(No.1/2 tuna can, 7 ounce net weight) to be incorporated in that agency's Wholesale Price Index. That Bureau also uses the quotation to compute an individual index for canned tuna, an index for the canned fishery products sub-group, and an over-all fish and shellfish index (1947-49 = 100).

In 1948 the Fish and Wildlife Service and the United States Bureau of Labor Statistics (after consultation with various fishery trade groups) determined that canned tuna should be one of the fishery items which was to be included in the revised Wholesale Price Index which the Bureau of Labor Statistics was working on. Solid pack, light meat tuna was picked as the most representative of the different styles of canned tuna available at that time. This style of pack represented the greatest proportion of the total tuna pack at that time. In the meantime, specifically since 1950, the pack of chunk-style, light-meat tuna has increased.

Canned tuna prices for advertised brands and private labels do not generally move or change simultaneously. In order to give representation to both types of tuna in the index, the price supplied to the United States Bureau of Labor Statistics for inclusion in the Wholesale Price Index is a composite price for advertised brands and private labels. The composite price is computed in the following manner: In a particular week the average price for advertised brand solid-pack, light-meat tuna is $15.00 per case, and the price for private label solid-pack, light-meat tuna is $14.00 per case. By talking to brokers and cannery representatives it is determined that 80 percent of the tuna entering trade channels during that week is advertised brands. Assigning a weighting of 80 percent to the price for advertised brands, the composite price (based on the above two quotations) for advertised brands and private labels would be $14.80 per case.

Although some critics of this method of computing a price for canned tuna contend that quoting one grade of canned tuna does not show variation in prices for all grades and packs of canned tuna, it must be remembered that for index purposes it is not feasible to give representation to all types and grades of a particular commodity. It is only possible to pick one type or grade which, over a long period of time, approximates the over-all price movement of a substantial part of the total of that commodity entering trade channels. It is impossible in an index of the type compiled by the United States Bureau of Labor Statistics to include all grades or major varieties of a certain commodity. The Bureau prices over 2,000 commodities. If prices for all grades and types of commodities were to be included, the cost of computing the index would be prohibitive.

If the pack of chunk-style, light-meat tuna continues to increase, it will be necessary to link the price for this style of tuna into the Wholesale Price Index and discontinue the pricing of solid-pack, light-meat tuna. Before doing this, however, it would be wise to delay making the change until it is determined that the new standards which are being established by the Food and Drug Administration in cooperation with the tuna industry do not lead to further changes in the style of pack. In order for an index series to be of value, it is necessary that the series have a list of items which is not changed too often. Otherwise, the index will lose its value because of defects in comparability.

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CHAPTER VIII - GOVERNMENT ASSISTANCE TO THE TUNA INDUSTRY IN THE UNITED STATES AND IN COMPETING COUNTRIES

ABSTRACT

GOVERNMENTAL AID IN VARYING DEGREES IS GIVEN TO THE FISHING INDUSTRY OF THE UNITED STATES AND 25 OTHER COUNTRIES STUDIED. SOME OF THIS AID ACCRUES TO THE TUNA INDUSTRIES OF MANY OF THOSE COUNTRIES. THE UNITED STATES AND THE 25 OTHER COUNTRIES ALL LEVY AN IMPORT DUTY ON CANNED TUNA AND TUNALIKE FISHES BUT IN SOME COUNTRIES FRESH OR FROZEN RAW TUNA ENTERS AS AN IMPORT, FREE OF DUTY.

THE RECONSTRUCTION FINANCE CORPORATION HAS MADE SOME LOANS TO MEMBERS OF THE DOMESTIC TUNA INDUSTRY.

THE INTER-AMERICAN TROPICAL TUNA COMMISSION IS ENGAGED IN A SCIENTIFIC RESEARCH PROGRAM WHICH HOWEVER HAS BEEN LIMITED DUE TO A SHORTAGE OF OPERATING FUNDS.

EXPLORATION FOR NEW TUNA GROUNDS HAS BEEN UNDER WAY FOR SEVERAL YEARS BY THE SERVICE IN THE CENTRAL PACIFIC OFF THE ATLANTIC COAST AND IN THE GULF OF MEXICO.

A BEGINNING HAS BEEN MADE IN RESEARCH DESIGNED TO PROVIDE LIVE BAIT SUBSTITUTES.

THE UNITED STATES DEPARTMENT OF STATE IS DEVOTING ATTENTION ON A CONTINUING BASIS TO THE REDUCTION OF AREAS OF FRICTION AND MISUNDERSTANDING IN INTERNATIONAL RELATIONS AFFECTING THE TUNA INDUSTRY.

IF THE TUNA FISHING INDUSTRY IS TO CONTINUE ITS VITAL FOOD PRODUCTION, THE PROBLEM OF SKILLED MANPOWER WARRANTS THE INCREASED CONSIDERATION OF GOVERNMENT.

SCOPE OF INVESTIGATION OF THIS SUBJECT

The investigation of this subject extends to the assistance given to fishery enterprises by the United States and by foreign Governments as far as they are active in tuna fishing or processing of tuna products, both inclusive of tunalike fish, or as far as they are considered potential future competitors of the American tuna industry. Besides the United States, the following countries were considered: In Asia,--Japan and the Philippines; in North America,--Canada and Mexico; in South America,--Chile, Peru, Venezuela, and Ecuador; in Central America,--Panama, Costa Rica, Nicaragua, El Salvador, Guatemala, Honduras, and Mexico; in Europe,--The United Kingdom, The Netherlands, Denmark, Norway, Spain, Portugal, Italy, and France; in Oceania,--Australia and New Zealand.

As can be expected, the most detailed information is available for the United States. With regard to many countries, information was not available on all subject matters which were of interest in this investigation. The most regrettable fact is that statistical data, if available, are often sporadic and refer to different calendar or fiscal years. The investigation itself did not give preference to countries with greater production of tuna and tuna-like fishes and products processed therefrom. As far as the search for information is concerned, all countries considered were treated as of equal importance. The investigation was extended to the aid given by central Governments, as distinguished from provincial or local aid. It was not overlooked that, in some countries, practically all aid to the fisheries is granted by the central Government while, in others, for example; in the United States and Canada, substantial assistance is also extended by State, provincial, or local Governments. However, such State, provincial, or local assistance was mentioned only as far as it was deemed advisable to found up the information.

SOURCES OF INFORMATION

Information was obtained in the United States from budget reports; budget estimates; annual reports of Federal and State fishery administrators; from hearings before Congressional Committees, especially before the Committee on the Merchant Marine and Fisheries, House of Representatives; from material available in the libraries of the Department of the Interior, of the Department of Agriculture, of the Department of State, and of the Library of Congress. The official publications issued by various foreign Governments were also utilized for additional and more recent data. Most valuable information was obtained from special reports prepared by Foreign Service Officers of the Department of States, and from the documentary evidence submitted by them. The Reconstruction Finance Corporation also prepared a report on its activity with respect to the domestic tuna industry. Available information was gathered in the United States Department of Commerce. About 20 "desk" officials within the Department of Commerce, Office of International Trade, were interviewed in connection with this investigation. Information also was obtained from the Office of the Special Assistant for Fisheries and Wildlife to the Under Secretary of State and from the Fishery Attache of the United States in Tokyo, Japan.

Interviews were held with officials of the Fish and Wildlife Service who have been regularly stationed in foreign countries, and were temporarily available in Washington, D. C., as well as with other persons who were formerly stationed in official capacity in foreign countries and whose knowledge of the interrelation of fisheries and Governments in such countries could advantageously be used for this investigation. In many cases, it was not possible to obtain direct information on the assistance given in foreign countries to the tuna fisheries, while information was available as to the assistance given to fisheries generally. In such cases, an estimate had to be made as to the relationship, present or potential, of the fisheries as a whole to the tuna fisheries, or vice versa. On the basis of these estimates, some evaluation of the policies prevailing or to be expected for the tuna fisheries could be made. Specific emphasis was laid on the collection of data which would show the protective tariff duties which are applied in foreign countries in the interest of the tuna industries. About 15 tariff specialists of the Department of Commerce, Office of International Trade, were helpful in collecting that data.

CLASSIFICATION OF THE VARIOUS TYPES OF GOVERNMENTAL ASSISTANCE

In the present investigation, all governmental assistance extended to fishery enterprises classifies into three main categories: (1) Bounties or subsidies, which may be direct or indirect; (2) emergency relief; and (3) other governmental aid.

Under bounties and subsidies are listed governmental grants made to fisheries enterprises in connection with the various phases of fisheries operations, and the special privileges which tend to lessen the costs of such activities. Bounties and subsidies are subclassified as: (1) direct, and (2) indirect assistance. Under direct assistance are grouped payments by the Government of sums of money to fishermen either in consideration of certain past performances, or with a view to defraying a part of the costs of future undertakings, but, in both cases, upon compliance with specific requirements set up by the Government. Such direct bounties and subsidies (direct assistance) are: bounties paid to fishermen, or to owners of fishing vessels for engaging in fishing operations for a specified length of time and bounties paid upon the exportation of fisheries products; subsidies granted for the construction or repair of fishing vessels; other direct subsidies for example, subsidies granted toward the erection or operation of freezing establishments and other miscellaneous direct subsidies. All direct bounties and subsidies are non-recoverable cash outlays by the Government, and reach the recipients in the form of direct cash payments.

In the case of indirect bounties and subsidies (indirect assistance), cash payments are not made directly to fisheries enterprises; the Government either lessens the costs of operations by granting certain privileges, entirely relieves the fisheries enterprises from carrying on certain necessary activities, or extends financial accomodation in the form of loans which, otherwise, would not be obtainable. Thus, indirect bounties and subsidies are, for example: governmental loans or guarantees of loans to fisheries enterprises; miscellaneous indirect subsidies for example, home market promotion activities carried on by the government; and exemptions from customs duties or from taxes on commodities used in fisheries. It appears that the governmental loans are the most important type of indirect bounties and subsidies granted to fishermen. With the exception of loans, all indirect assistance represents non-recoverable cash outlays or losses on the part of the government.

Another form of aid which is indirect and sometimes results in financial benefit to fishermen is the practice of some nations to maintain ice or refrigerated warehouses in fishing districts. The governments usually charge a fee for the use of these facilities but often it is an amount considerably under what the fishermen would have to pay for the service if any private firm were at all disposed to conduct the service.

Other cash payments to fishermen which do not constitute an integral part of definite governmental policies toward fisheries, and do not represent normally recurring encouragement to the fishing industry, are lumped under "Emergency relief". This aid, going to needy fishermen, was called into existence by extraordinary conditions, and is likely to cease with the improvement of general economic conditions in the respective countries.

Finally, under "Other Governmental Aid", are listed all other types of assistance, classed in two main groups: (1) facilitation services, and (2) administrative functions of departments or bureaus of fisheries. In contrast to bounties and subsidies which generally are reducible to monetary terms with regard to individual fishermen or fisheries organizations, the benefits accruing from "Other Governmental Aid" do not lend themselves to monetary measurements, either individually or collectively. The funds expended in the form of "Other Governmental Aid" are, in most cases, non-recoverable.

Governmental activities which tend to improve the basic conditions of fisheries operations are classified as facilitation services. These services include fish protection and propagation research and investigation, the improvement of port facilities, and other activities affecting the general working conditions of fishermen; for example, biological, statistical, and economic research, technological assistance, dissemination of information, and education of fishermen.

In some countries, expenditures for so-called facilitation services probably include items of expense which, in fact, were expended for administrative functions, and vice versa.

"Administrative functions" cover chiefly the routine activities of the fisheries bureaus. Part of the expenditures under this head have to do with the general supervision of fisheries and with the administration of the various other forms of aid to fisheries. Others are for the enforcement of fishery laws, such as those designed to prevent excessive depletion of waters, or to assure the quality of the product marketed. In some countries, part of the expenditure is for the collection of statistics of the fisheries.

Summary of Findings

Some governmental aid is given to fisheries in all the 26 countries examined. The specific aid to the tuna fisheries could only, in few cases, be separated from the aid which was given to the fisheries generally in the respective country. Where the assistance, given to the tuna industry, could not be eliminated, it was assumed that the assistance given to that industry is in about the same proportion to the assistance given to the fishery industry generally as the catch of tuna and tunalike fishes is to the total catch by quantities or by values respectively. With regard to some countries in which tuna or tunalike fishes are not landed or with regard to countries in which tuna or tunalike fishes are landed in very small quantities only, assistance given to the fisheries generally was discussed when it was assumed that the countries in question will in the near future develop tuna fishing or a tuna processing industry.

A few countries give direct subsidies to their fisheries either in the form of bounties, grants for vessel construction or other direct grants. Only 7 out of 26 countries were found to assist with such direct subsidies which are considered to be non-recoverable losses for the government treasury in question. Seventeen countries out of 26 make loans to fishermen or fishery industrial corporations. for the development of their industry, mostly for the acquisition or reconditioning of vessels. The United States is included among these seventeen since the Reconstruction Finance Corporation is active in this field. Some information about its activity is given later in this chapter. Seven countries out of 26 give quarantees of such loans when the loans are advanced from private sources.

Only a few countries, namely five, maintain public ice or refrigerated warehouses for the use of fishermen or fish processors. Seven countries provide for emergency relief in the case of disaster, hurricanes or as consequence of war emergencies.

Twenty-one out of 26 countries are engaged in biological research and 20 countries give assistance for fishery technological research. Only 16 countries support fish propagation by public funds. Fishermen's schools and fishermen's colleges are supported by government contributions in 12 countries. Exploratory fishing is supported by the respective governments in 10 countries.

The importance of the fishery products as objects of international or national trade can be seen from the fact that 15 countries have set aside funds to support marketing and marketing research. Only 13 countries support regular statistical data collection. The same 13 countries have set aside appropriations for economic research. Twelve countries give assistance by dissemination of information, mostly concerning the results of biological studies or exploratory fishing. Some countries also make available to the fishery industries regular marketing reports as well as trade conditions in foreign states. Five countries provide special legislation for certain types of fishery enterprises for example, for fishery cooperative assistance, for fishery export associations or for fishery monopolies.

Specific efforts were made to collect data on tax or duty exemptions for fisheries, protective tariffs and quota systems imposed on fisheries. Ten countries show exemptions for certain taxes or duties for fisheries either in the form of tax exemptions on gasoline, motors, or other equipment used in the fishery industries or in the form of duty free importation of such equipment. All countries but the United States, Denmark, Norway, and Nicaragua, levy an import duty on fresh and frozen fish, especially fresh and frozen tuna. But, of these four countries, three, namely; Denmark, Nicaragua, and Norway have established import and exchange license systems which at present are prohibitive to any importation of any fresh or frozen tuna. Consequently, only the United States permits duty free importation of fresh and frozen tuna without any restrictions as to quotas and international payments. (Italy permits the duty-free importation of fresh and frozen tuna for canning in Italy. However, it does not issue import permits for imports from hard currency countries.) All together 21 countries at present apply a strict control on monetary exchange and on imports which makes practically impossible the importation of tuna and tunalike fish products. All 26 countries levy an import duty on canned tuna and tunalike fishes.

For further details with respect to the various types of assistance rendered to the tuna industries of the various countries studied see table 84. More detailed information was obtained, such as amounts expended for direct aids, etc., but space does not permit the reproduction of that information here.

Details of the import duties of each country are given in table 85. The comparative effect of the various duties levied are given in table 86 where a price of 15 cents (U. S.) per pound net and a price of 60 cents (U. S.) per pound gross has been assumed to determine the effect of duties of all countries.

TABLE 84. - GOVERNMENT ASSISTANCE TO THE TUNA INDUSTRY IN THE UNITED STATES AND COMPETING COUNTRIES AS OF FEBRUARY 1, 1953

Country	Types of Assistance Rendered					
	Fishing Bounties	Subsidies for Vessel Construction	Other Direct Subsidies	Government Loans	Government Guaranties	Miscellaneous Indirect Subsidies
United States	-	-	-	X	X	X
Canada	X	X	X	X	X	X
Mexico	-	-	-	-	-	-
Guatemala	-	-	-	-	-	-
Panama	-	-	-	-	-	-
El Salvador	-	-	-	-	-	X
Honduras	-	-	-	X	-	-
Nicaragua	-	-	-	-	-	-
Costa Rica	-	-	-	X	-	-
Venezuela	-	-	X	X	-	X
Ecuador	-	-	-	-	-	-
Peru	-	-	-	X	-	-
Chile	-	-	-	X	-	-
Columbia	-	-	-	X	-	-
Japan	X	X	X	X	X	X
Philippines	-	-	-	X	-	-
Australia	-	-	-	-	-	-
New Zealand	-	-	-	-	-	-
United Kingdom	X	X	X	X	X	X
The Netherlands	-	-	-	X	X	-
Denmark	X	-	-	-	X	-
Norway	X	X	X	X	-	X
France	-	-	-	X	X	-
Spain	-	-	-	X	-	-
Portugal	-	-	-	X	-	-
Italy	-	-	-	X	-	-

- Assistance not rendered.

X Assistance rendered.

(Continued on next page)

TABLE 84. – GOVERNMENT ASSISTANCE TO THE TUNA INDUSTRY IN THE UNITED STATES AND COMPETING COUNTRIES AS OF FEBRUARY 1, 1953 – Continued

Country	Types of Assistance Rendered				
	Tax or Duty Exemption	Protective Tariff (Raw Fish)	Protective Tariff (Canned Fish)	Import Licensing	Maintenance of Ice–or Refrigerator Warehouses
United States	X	–	X	–	–
Canada	–	X	X	–	X
Mexico	–	X	X	–	–
Guatemala	–	X	X	–	–
Panama	X	X	X	–	–
El Salvador	X	X	X	X	–
Honduras	–	X	X	X	–
Nicaragua	–	–	X	X	–
Costa Rica	X	X	X	X	–
Venezuela	–	X	X	X	–
Ecuador	–	X	X	X	–
Peru	–	X	X	X	X
Chile	X	X	X	X	–
Columbia	–	X	X	X	–
Japan	–	X	X	X	X
Philippines	X	X	X	X	–
Australia	–	X	X	X	–
New Zealand	–	X	X	X	–
United Kingdom	X	X	X	X	X
The Netherlands	–	X	X	X	–
Denmark	–	–	X	X	–
Norway	–	–	X	X	X
France	X	X	X	X	–
Spain	–	X	X	X	–
Portugal	X	X	X	X	–
Italy	X	X	X	X	–

– Assistance not rendered.

X Assistance rendered.

(Continued on next page)

TABLE 84. - GOVERNMENT ASSISTANCE TO THE TUNA INDUSTRY IN THE UNITED STATES AND COMPETING COUNTRIES AS OF FEBRUARY 1, 1953 - Continued

Country	Types of Assistance Rendered					
	Other Governmental Aid					
	Emergency Relief	Biological Research	Fish Propagation	Technological Research	Fishermen's Schools	Port Facilities
United States	X	X	X	X	X	-
Canada	-	X	X	X	X	X
Mexico	X	X	-	-	X	X
Guatemala	-	-	-	-	-	-
Panama	-	X	X	-	-	-
El Salvador	-	-	-	X	-	X
Honduras	-	X	-	X	-	-
Nicaragua	-	-	-	-	-	-
Costa Rica	-	-	-	X	-	-
Venezuela	-	X	-	X	-	X
Ecuador	-	-	-	-	-	-
Peru	-	X	X	X	-	-
Chile	-	X	X	X	X	X
Columbia	-	X	-	-	-	-
Japan	X	X	X	X	X	X
Philippines	-	X	X	X	X	-
Australia	-	X	X	X	X	X
New Zealand	-	X	X	X	X	X
United Kingdom	X	X	X	X	X	-
The Netherlands	-	X	X	X	-	-
Denmark	-	X	X	X	X	X
Norway	X	X	X	X	X	X
France	-	X	X	X	X	X
Spain	X	X	X	X	-	-
Portugal	X	X	X	X	-	-
Italy	-	X	-	X	-	X

- Assistance not rendered.

X Assistance rendered.

(Continued on next page)

TABLE 84. - GOVERNMENT ASSISTANCE TO THE TUNA INDUSTRY IN THE UNITED STATES AND COMPETING COUNTRIES AS OF FEBRUARY 1, 1953 - Continued

Country	Types of Assistance Rendered				
	Other Governmental Aid				
	Exploratory Fishery	Marketing Services	Statistics and Economic Research	Information Services	Legislative Preferences
United States	X	X	X	X	X
Canada	X	X	X	X	-
Mexico	-	X	X	X	X
Guatemala	-	-	-	-	X
Panama	-	-	-	-	X
El Salvador	X	X	-	-	X
Honduras	-	-	-	-	-
Nicaragua	-	-	-	-	-
Costa Rica	-	-	-	-	X
Venezuela	-	X	-	-	X
Ecuador	-	-	-	-	X
Peru	-	X	X	-	-
Chile	X	X	X	X	-
Columbia	-	-	-	-	X
Japan	X	X	X	X	-
Philippines	-	X	-	X	-
Australia	X	X	X	X	-
New Zealand	-	-	X	-	-
United Kingdom	X	X	-	X	X
The Netherlands	-	X	X	X	X
Denmark	X	X	X	X	X
Norway	X	X	X	X	X
France	-	-	X	-	-
Spain	-	-	-	-	X
Portugal	-	-	-	-	X
Italy	X	X	X	X	-

- Assistance not rendered.

X Assistance rendered.

TABLE 85. – IMPORT TARIFF RATES OF FRESH, FROZEN AND PROCESSED TUNA
IN SPECIFIED COUNTRIES, AS OF FEBRUARY 1, 1953

Importing Country	Part I – Fresh and Frozen				
	Rate	Rate Base	Currency Equivalent	Additional Taxes	Remarks
United States	Free	–	–	–	–
Canada	1/2 cent (fresh)	per pound net	1 C. dollar = $1.01	–	British Commonwealth preference
	1/2 cent (fresh)	per pound net	–	–	Most Favored Nations (U. S.)
	1 cent	per pound – net	–	–	General
	15% (frozen)	ad valorem	–		British Commonwealth preference
	17-1/2% (frozen)	ad valorem	–	–	Most Favored Nations (U. S.)
	25% (frozen)	ad valorem	–	–	General
Mexico	.10 pesos plus	per kilogram	1 peso = $0.23	3% of duty on freight or express shipments. 10% of duty on parcel post	
	10%	ad valorem			
Panama	0.05 balboas	per gr. kg.	1 balboa = $1.00		
Guatemala	U.S. equivalent 3 cent plus	per gr. kg.		2% toll tax on import charges. 10 cents tax on each imported package	
	6%	ad valorem			
Honduras	.62 lempiras plus 10% surtax on duty plus	per gr. kg.	2 lempiras = $1.00	Road tax 1% ad valorem Wharfage tax 0.01 lempiras per gross kg. Portage and storage fee 0.01 per gross kg. Toll tax 0.02 per gross kg.	
	8% Consular fee	ad valorem		Special surtax) 0.01 per) gross kg.)	not U. S.
El Salvador	35 colones (gold)	per hundred gr. kg.	1 gold colones = $1.00		
Nicaragua	Free				

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TABLE 85. - IMPORT TARIFF RATES OF FRESH, FROZEN AND PROCESSED TUNA IN SPECIFIED COUNTRIES, AS OF FEBRUARY 1, 1953 - Continued

Importing Country	Part I - Fresh and Frozen				
	Rate	Rate Base	Currency Equivalent	Additional Taxes	Remarks
Costa Rica	80 colones plus 4%	per gr. kg. ad valorem	1 colones = 14.3 cents		Imports at present prohibited
Venezuela	2 bolivars	per gr. kg.	1 bolivar = 30 cents		Imports of fresh and frozen tuna licensed. Under quota.
Ecuador	2 sucres plus 13-1/2% Import Tax plus 44% Exchange Tax	per gr. kg. ad valorem ad valorem	1 sucre = 6.25 cents		
Peru	U. S. equivalent 3.225 cents plus 11.667%	per gr. kg. ad valorem (duty paid)			Import licenses are given only in exceptional cases
Chile	U. S. equivalent 27.8 cents plus 20%	per gr. kg. ad valorem (duty paid)			No license at present given.
Columbia	30 centaves plus 25%	per gr. kg. ad valorem	1 centave = .4 cents		Imports at present prohibited
Philippines	$4.50 free from U. S. A.	per gr. kg.			Imports restricted to a quota of 5% of 1949 imports (frozen tuna)
Japan	10%	ad valorem			No imports permitted at present.

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TABLE 85. - IMPORT TARIFF RATES OF FRESH, FROZEN AND PROCESSED TUNA
IN SPECIFIED COUNTRIES, AS OF FEBRUARY 1, 1953 - Continued

Importing Country	Part I - Fresh and Frozen				
	Rate	Rate Base	Currency Equivalent	Additional Taxes	Remarks
Australia	1 pence for Commonwealth Countries	per lb. gross per lb. gross	1 £ = $2.24 1 d = .93 cents	12-1/2% Sales tax	Imports from hard currency countries not permitted
General tariff	(1-1/2 pence (plus (10%	per lb. gross ad valorem			
New Zealand	10 shillings (for Commonwealth Countries and Preferred Nations) 15 shillings all other free from Australia	per 112 lb. net (ctw.) 112 lb. net	1 £ = $2.80 1 shilling = 14 cents	22.5% Surtax of duty	No imports at present permitted
United Kingdom	10% free from Commonwealth Countries	ad valorem	1 £ = $2.80	-	Import licenses required for most countries and if transported on Non-Commonwealth Vessels.
The Netherlands	-	-	4-1/2% Turnover Tax		Licenses for imports required
Denmark	-	-			Licenses required
Norway	-	-			Licenses required
France	Trade Agreement Countries 33% (min. 12.5 franc) General 99%	ad valorem ad valorem	1 franc = .28 cents	1% transaction tax (on goods plus duty)	Licenses at present not issued
Spain	.252 gold pesetas	per net kg.	1 gold pesetas = 32.6 cents		Licenses at present not issued
Portugal	General Trade Agreement Countries 0.05 g. esc. (during Sept. and Jan.) 0.001 g. esc.	0.025 g. osc. per net kg. 0.001 g. esc.	1 gold escudo = 86 cents	60% Surtax on duty	Licenses at present not issued
Italy	General Trade Agreement Countries 30% free for canning in Italy	18% ad valorem	1 lira = .16 cents	-	Licenses only issued for soft currency countries.

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TABLE 85. - IMPORT TARIFF RATES OF FRESH, FROZEN AND PROCESSED TUNA, IN SPECIFIED COUNTRIES, AS OF FEBRUARY 1, 1953 - Continued

porting ountry	Part II - Canned				
	Rate	Rate Base	Currency Equivalent	Additional Taxes	Remarks
ited tates	Tuna in oil 45%	ad valorem			
	Tuna in brine 12-1/2%	ad valorem			
	Bonito in oil 22%	if not over 9 cents per lb.			
	Bonito in oil 15%	ad valorem, if more than 9 cents per lb.			
	Bonito in brine 12-1/2%	ad valorem (Cuba 10%)			
nada	In oil 20%	ad valorem	1 C. dollar = $1.01		British Commonwealth Pref.
	In oil 20%	ad valorem			[illegible] Most Favored Nation (U.S.)
	In oil 25%	ad valorem			General
	In brine 17-1/2%	ad valorem			British Commonwealth Pref.
	In brine 22-1/2%	ad valorem			Most Favored Nation (U.S.)
	In brine 30%	ad valorem			General
xico	80 pesos	per kilogram	1 peso = 23 cents	3% of duty on freight and express shipments. 10% of duty on parcel post	
	plus				
	35%	ad valorem			
nama	0.05 balboas	per gr. kg. weight	1 balboas = $1.00		
atemala	U. S. equivalent 30 cents	per gr. kg.	-	2% toll tax on import charges, 10 cents tax on each imported package	
	plus				
	6%	ad valorem			
nduras	.42 lempiras	per gr. kg.	2 lempiras = $1.00	Road tax 1% ad valorem Wharfage tax 0.01 lempiras per gr. kg. Portage and storage fee 0.01 per gr. kg.	
	plus				
	10% surtax on duty				
	plus				
	8% Consular fee	ad valorem		Toll tax 0.02 per gr. kg. Special surtax 0.01 per gr. kg.	not U. S.

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TABLE 85. - IMPORT TARIFF RATES OF FRESH, FROZEN AND PROCESSED TUNA, IN SPECIFIED COUNTRIES, AS OF FEBRUARY 1, 1953 - Continued

Importing Country	Part II - Canned				
	Rate	Rate Base	Currency Equivalent	Additional Taxes	Remarks
El Salvador	51.40 gold colones	per hundred gr. kg.	1 gold colones = $1.00		General
	29.29 gold	per hundred gr. kg.			(Import from Most Favored Nation) (U. S.)
Nicaragua	.41 cordobas	net kg.	5 cordobas = $1.00		Import license fixed exchange 10 cordovas = $1.00
Costa Rica	1.50 colones plus 4%	per kg. ad valorem	1 colones = 14.3 cents		Import licenses not issued at present
Venezuela	2 bolivars	per gr. kg.	1 bolivar = 30 cents		Imports at present not prohibited or subject to license
Ecuador	1.75 sucres plus 17% Import Tax plus 33% Exchange Tax	per net kg. ad valorem ad valorem	1 sucre = 6.25 cents		
Peru	U. S. equivalent 6.45 cents plus 11.667%	per gr. kg. ad valorem (duty paid)			Import licenses are given only in exceptional cases.
Chile	U. S. equivalent 36.05 cents plus 20%	per gr. kg. ad valorem (duty paid)			No license at present given
Columbia	80 centaves plus 25%	per gr. kg. ad valorem	1 centave = .4 cents		Imports at present prohibited
Philippines	20% free from U. S. A.	ad valorem			Imports restricted to a quota of 5% of 1949 imports

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TABLE 85. - IMPORT TARIFF RATES OF FRESH, FROZEN AND PROCESSED TUNA, IN SPECIFIED COUNTRIES, AS OF FEBRUARY 1, 1953 - Continued

porting ountry	Part II - Canned Rate	Rate Base	Currency Equivalent	Additional Taxes	Remarks
pan	20%	ad valorem			No imports permitted at present
stralia	1 pence for Commonwealth Countries	per lb. gross	1 £ = $2.24 1 d = .93 cents	12-1/2% Sales tax	Imports from hard currency countries not permitted
	3 pence for Most Favored Nations	per lb. gross			
General Tariff	(3 pence (plus (10%	per lb. gross ad valorem			
w ealand	1-1/2 d (for Commonwealth countries)	per lb. gross	1 £ = $2.80 1 shilling = 14 cents	plus 22.5% surtax of duty	No imports at present permitted
	2-1/2 d Most Favored Nations (U.S.A.)	per lb. gross			
	3 d (all other)	per lb. gross			
	from Australia - free				
ited ingdom	10% free from Commonwealth countries	ad valorem	1 £ = $2.80		Import licenses required from most countries
e etherlands	20%	ad valorem		4-1/2% Turnover Tax	Licenses for imports required
nmark	.24 kroner	per gr. kg.	1 krone = 14.5 cents		Licenses required
rway	1 krone	per gr. kg.	1 krone = 11 cents		Licenses required
ance	Trade Agreement Countries 25%	ad valorem	1 fr. = .28 cents	1% transaction tax plus 15.35 surtax (on goods ≠ duty)	Licenses at present not issued
	General 75%	ad valorem			
ain	3.63 gold pesetas	per net kg.	1 gold peseta = 32.6 cents		Licenses at present not issued
rtugal	General Trade Agreements Countries In brine .16 esc. .08 esc. In oil .40 esc. .20 esc.	per net kg.	1 gold escudo = 86 cents	60% surtax	Licenses at present not issued
aly	Trade Agreement Countries 22.5%	ad valorem	1 lira = 16 cents		Licenses only issued for soft currency countries
	General 40%				

TABLE 86. - COMPARATIVE IMPORT DUTIES ON TUNA IN CENTS PER POUND,

AS OF FEBRUARY 1, 1953

Assumed Price of Fresh Tuna = 15 cents per pound net

Assumed Price of Canned Tuna in Oil = 60 cents per pound gross

Cents Per Pound					
Country	Fresh (net)	Canned in oil (gross)	Country	Fresh (net)	Canned in oil (gross)
United States	free	27.0	New Zealand	1.6 (Commonwealth Country) (Most Favored Nation) 2.4 (General)	2.1 (Commonwealth Country) 3.7 (Most Favored Nation) 4.4 (General)
Canada	1.0 (Most Favored Nation .5) (Commonwealth Country .5)	15.0 (Most Favored Nation .12) (Commonwealth Country .12)			
Mexico	2.0	25.0			
Panama	2.3	2.3	United Kingdom	1.5 (General) free (Commonwealth Country and U. S. A.)	6 (General) free (Commonwealth Country and U. S. A.)
Guatemala	2.3	17.1			
Honduras	16.6	15.3			
El Salvador	15	23.3 (Most Favored Nation 13.3)	Netherlands	free Duty tax 0.7	14.7
Nicaragua	free	4.1	Denmark	free	1.6
Costa Rica	5.7	12.2	Norway	free	5.0
Venezuela	27.0	27.0	France	15 (General) 5 Trade Agreement Country)	45 (General) 15 Trade Agreement Country)
Ecuador	14.3	29.0			
Peru	3.3	10.2			
Chile	15.6	28.4	Spain	3.7	53.6
Columbia	9.2	29.5	Portugal	3.2 (General) 1.6 (Trade Agreement Country)	25 (General) 12.5 (Trade Agreement Country)
Philippines	2.1	12.0			
Japan	1.5	12.0	Italy	4.5 (General) 2.7 (Trade Agreement Country) Free if imported for canning in Italy.	24 (General) 13.5 (Trade Agreement Country)
Australia	2.7 (For Commonwealth Country and Most Favored Nation) 4.7 (General)	8.5 (For Commonwealth Country 10.3 and Most Favored Nation) 16.3 (General)			

RECENT RECONSTRUCTION FINANCE CORPORATION EXPERIENCE IN THE DOMESTIC TUNA INDUSTRY[26]

Since its inception, the Reconstruction Finance Corporation has made 371 loans to the fishing and fish processing industry. Total loan authorizations amounted to $23.8 million, of which $4.3 million was banks' shares in participation loans.

The basic law under which Reconstruction Finance Corporation operates provides that no business loan shall be made unless the credit is not otherwise available on reasonable terms. It is apparent then that normal financial and credit channels were unable or unwilling to furnish the funds needed in these loans.

Reconstruction Finance Corporation participation loans, both immediate and deferred, enabled many banks to make and service loans to their customers where size of loan or other considerations would have prevented their making the loans completely on their own. In addition, banks and the Reconstruction Finance Corporation frequently cooperated in credit arrangements wherein Reconstruction Finance Corporation extended the desired term loan while the bank agreed to take care of short term working capital and inventory loan requirements.

It is not possible, in the limited time available,[26] to determine which of the 371 loans were made to West Coast tuna fishers and packers. It may be of value, however, to discuss briefly the aspects of some typical loans made recently in that area.

1. A loan of $150,000, with a maturity of 38 months, made to a California firm which processes and packs tuna, sardines, and mackerel, and also produces fish meal and oil. The company was established about 20 years ago. Its loan request was declined by three California banks, for the

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26/ Prepared by Economic Analysis Staff, Office of the Controller Reconstruction Finance Corporation, as requested by the Fish and Wildlife Service in the closing days of the present survey.

reason that a long-term working capital loan would be unattractive to them. One of the banks, however, agreed to establish a $400,000 short-term line of credit on receivables and inventory provided the firm could either raise $150,000 in new capital or Reconstruction Finance Corporation would make a term loan in that amount. The bank expressed entire satisfaction with previous loans to the firm, and was confident of the capabilities of its management. The firm was unable to raise outside capital, and the loan was authorized by Reconstruction Finance Corporation under its regular business loan authority.

2. A loan of $350,000, to be made by a bank, with a 50 percent deferred participation by Reconstruction Finance Corporation. The borrower, originally established over 40 years ago, is a canner and processor of tuna, sardines and other fish, and also produces fish meal and oil. The loan is for a 10-year term. The application was brought by the bank to Reconstruction Finance Corporation. The amount of the loan would have far exceeded 10 percent of the banks' capital and surplus.

3. A loan of $5,500 to a veteran, to assist him in the purchase of a fishing boat for salmon, tuna and crab, payable in 5 years. Two Washington banks from whom the credit was requested were not interested in making fishing boat loans of this type. The loan was partially guaranteed by Veterans' Administration.

4. A loan of $400,000 to a California tuna and sardine packer. The applicant will use $300,000 for operating capital and $100,000 for new equipment and machinery. His request was declined by two banks because of its capital nature and long maturity. However, one of the banks will make available up to $350,000 for current packing operations. Applicant has been in business over 30 years, and has been a valued customer of this bank for many years.

5. A 5-year loan of $10,000 to apply on the cost of completing and equipping a commercial fishing boat for salmon and tuna. Three Washington banks declined because they are not making long-term fishing boat loans at this time.

WHAT CAN GOVERNMENT DO TO HELP AMERICAN TUNA FISHING IN THE FUTURE?

The various types of government assistance rendered to the domestic tuna industry by the United States Government have been indicated or mentioned briefly. More detailed consideration was given to activity which government could undertake to help American fishing in the future. A discussion of this follows under the three headings technical assistance, international relations and manpower.

Technical Assistance

Lack of basic knowledge on the life history, movements, and abundance of the various species of tuna has been a contributing factor to the problems faced by the American tuna industry and the various countries off which tuna are caught. The Inter-American Tropical Tuna Commission[27] is engaged in a scientific research program studying both the tuna and tuna bait resources in an effort to establish basic knowledge upon which a sound evaluation of the extent and potentialities of the tuna populations may be made and which can be used, if and when needed, in fixing regulations to insure protection of the tuna and bait resources from possible depletion. The convention between the United States and Costa Rica establishing the Commission judiciously included a provision (Art. V, par. 3) by which any nation whose nationals participate in the tuna fishery may become a member. This is, then, a basic tool by which, and around which, a program of cooperative research and friendly and equitable relations can be built and maintained. In the past the research program of the Commission has been limited due to a shortage of operating funds. Members of the tuna industry have expressed the opinion that one of the most important things the Government can do is provide the Commission with sufficient funds to carry out its proposed program of tuna research.

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[27] Established by a convention between the United States and Costa Rice, signed at Washington, May 31, 1949.

Exploration of possible new tuna grounds has been underway by the Fish and Wildlife Service for the past several years in the Pacific, the Gulf of Mexico, and off the Atlantic seaboard. Results are promising for the establishment of new commercial tuna fisheries in all these areas. If these projects were to be continued and expanded they would provide knowledge of new resources which may be available to maintain or increase the needed production of tuna. Research on new and modified types of fish gear to increase efficiency, as well as electronic experiments in locating schools of fish such as tuna, are being conducted. It is believed by many tuna experts that alternate sources of live tuna bait or live bait substitutes can be found to relieve the fleet of this source of considerable expense and trouble. It has been proposed by the industry that the Fish and Wildlife Service undertake a broad-scale research program to develop an alternate bait for tuna. This is a field in which the Government can be of great assistance to the fishing industry, as private operators do not normally have the facilities or funds for systematic scientific research of this type.

International Relations[28]

As indicated in Chapter IV, the scope of American tuna fishing operations off foreign shores, together with the highly disordered state of foreign claims to fisheries control in adjacent waters, has conspired to confront the industry with a production problem that enters the field of international relations and raises questions of international law. The United States Department of State is devoting attention on a continuing basis to the reduction of areas of friction and misunderstanding in the matter. The encouragement and facilitation of the free exchange of factual information regarding the tuna fishery, both of an economic and scientific nature, is one way of meeting this objective. Another is the negotiation of appropriate agreements once valid bases therefor are established. These may relate to privileges within

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28/ Prepared by the Office of the Special Assistant for Fisheries and Wildlife to the Under Secretary of State, United States Department of State, as requested by the Fish and Wildlife Service.

recognized territorial waters, such as fishing, port privileges, shelter, etc., or they may be of a conservational or investigative character. The Inter-American Tropical Tuna Commission is an example of the latter. Secondly, the United States Department of State is continuing its policy of warding off, wherever possible, impending illegal seizures of other illegal molestation of United States fishing vessels by foreign authorities, and of rendering appropriate assistance where United States citizens do become so involved.

Manpower

Efficient tuna fishing is dependent upon team work and skill of the crew members. Vessel operators have recently expressed alarm over two developments which reportedly threaten to cause an acute shortage of skilled tuna fishermen to adequately man the vessels. Concern has been expressed that the McCarran-Walter Act, by eliminating fishermen from classification as seamen, will result in a number of experienced fishermen of foreign nationality being forced to leave the country. It is believed that approximately 150 tuna fishermen are affected. Up to the present, no reports have been received of a tuna vessel being tied up for lack of a crew, and it appears that there are a sufficient number of qualified fishermen to operate the fleet under present conditions. Secondly, there is a possibility of younger fishermen being taken into the armed forces by the draft. Manning the vessels with inexperienced fishermen reduces efficiency and raises the costs of production, thereby tending to reduce the competitive ability of American fishermen with foreign tuna-producing nations. It has been the policy to grant military deferments and even discharges to skilled fishermen who are essential to operation of a vessel. If the tuna fishery is to maintain its position as a vital food-producing industry, this problem of skilled manpower warrants increased consideration.

CHAPTER IX -- CONCLUSIONS AND RECOMMENDATIONS

Fifty years ago the tuna industry in the United States consisted of one cannery in southern California and a few vessels fishing in nearby waters. This cannery and these vessels created the industry that has made available the canned tuna now so widespread in domestic markets.

Since this inauspicious beginning the domestic pack of canned tuna and tunalike fishes has become more valuable than that of salmon, and more canned tuna is consumed per capita than salmon or any other canned fish. In attaining these premier positions the tuna industry has grown amazingly in size and complexity.

The onetime local fishing fleet of small boats has expanded to thousands of fishing craft including the largest, the most expensive, and the farthest ranging fishing vessels in the domestic fleet. The single cannery has grown to over forty canneries which include the finest examples of mechanized fish processing in the country. They have spread to Oregon, Washington, and Hawaii, and to Maine, Massachusetts, Maryland, and South Carolina. Others are projected for Mississippi and Puerto Rico.

Thousands of shoreworkers find year-round employment in the Pacific coast canneries and other thousands in service industries. Numerous fish plant workers on the Atlantic coast are finding that tuna canning helps to extend employment while processing based on local fisheries is at a low ebb. The first struggling efforts to create a market for canned tuna have given way to marketing organizations and promotional programs, the achievements of which may be measured best by the top ranking of canned tuna in per capita consumption, and by the frequency with which its desirability blazons forth in every type of advertising media.

Market demand coupled with domestic initiative and foreign competition have made the producing, processing, and marketing segments of the once simple tuna industry so complex that actions which benefit a fisherman may harm a processor, or, as in some cases, what may be to the advantage of one processor is to the disadvantage of another.

Once albacore was the only tuna canned. Now "tuna" includes yellowfin, skipjack, bluefin, and little tuna. And "tunalike" fishes include bonito and yellowtail. Ninety percent of the domestic catch is taken off the shores of foreign nations and the fishing operation is now subject to varying degrees of foreign control.

Until 1925, the domestic pack consisted only of tuna caught by domestic tuna fishermen. Then frozen whole tuna were imported and processed in domestic canneries, and shortly thereafter foreign canned tuna appeared on the United States market. The proportion of foreign tuna used by domestic canneries varies with their access to the domestic tuna landings. California packers are so situated that they can utilize both the domestic catch and imported frozen tuna advantageously. Pacific Northwest and Hawaiian canners have much more need for frozen imports to round out their packs, while Atlantic coast processors are almost wholly dependent, at present, on frozen imported tuna.

Importing of tuna, either canned or frozen, has become a significant part of the country's tuna industry. Foreign tuna, in one guise or another, accounted for 33.3 percent of the available supplies for the domestic market in 1952. And a new phase is just beginning. Importation of frozen cooked tuna loins is underway. When packing these loins a cannery eliminates all labor and processing steps up to the mechanical packing into cans. Trial shipments of imported frozen cooked tuna in open No. 1/2 tuna cans have been received recently. This type of import eliminates the need for labor and equipment up to the sealing machine and cooking retorts. Completing the canning process by sealing the cans and cooking the sealed product is a simple procedure. It does not require a tuna cannery since the sealing and cooking can be accomplished in the plant of almost any fruit or vegetable packer with the equipment used for the regular products.

The domestic tuna industry, in all its segments, is a progressive industry as its achievements over the past fifty years readily demonstrate. Its importance to the National interest is borne out by the World War II record of its fishing fleet and by the current statements of Federal agencies with regard to its importance to the National economy. But when the tuna industry created a desirable product and developed an increasing market for the product,it also created problems. These problems, left unsolved, could reduce the domestic tuna industry, as we know it now, to an insignificant operation insofar as fishing, processing, and a substantial part of the distributing function are concerned.

Undoubtedly all those involved with the domestic tuna industry in any respect agree that its problems should be studied and that attempts to solve the problems in an equitable manner should be made. Outlining the problems is not difficult. Suggesting solutions or methods of attack is much more difficult because of the diversity and conflict of interests.

The more pressing problems follow. They are not necessarily in order of importance nor of priority as to which should be attacked first. They are so interrelated that a decision on one usually affects the others.

1. How can the domestic fishing fleet continue to operate profitably and supply a fair share of the raw material for the canned tuna consumed in the domestic market when in competition with increasing imports of tuna in various forms?

The share of the market supplied by the domestic fishing fleet has declined with increasing imports, and vessels have been forced, at times, to cease fishing for extended periods when their market was oversupplied. Imports of tuna, whether frozen round, frozen cooked loins, frozen cooked in cans, or canned in oil or brine, are directly competitive with the landings of the domestic fleet.

Many units of the fleet are faced with operating unprofitably, ceasing operations, transferring to another type of activity -- which is difficult or impossible for most vessels — or transferring to a foreign registry.

2. How can domestic packers be assured of adequate raw materials to meet market demands for canned tuna?

Landings of tuna by the domestic fleet currently are not large enough to supply the needs of domestic canners. If additional restrictions were placed on imports of frozen round tuna, or frozen cooked tuna loins, to aid the fishing fleet, and the domestic catch could not be correspondingly increased, many canners would be seriously affected. Most California canners import tuna although most of the domestic tuna is landed there. Pacific Northwest canners require imported tuna because the local catch of albacore is highly variable and never large. Atlantic coast canners are almost wholly dependent on tuna from foreign sources as the local fisheries are unsure and undeveloped.

Diminished access to imports of frozen round tuna or frozen cooked loins, or an increase in their cost, would require canners to decrease and limit their markets, would increase their operating costs, and could stimulate transfer of canning operations to foreign countries.

3. How can domestic shore plant workers be assured of full employment in canneries utilizing tuna?

Imported frozen round tuna permits increased operation and greater employment since domestic landings of tuna currently are not large enough to supply the needs of domestic canners. If restrictions were placed on imports of frozen round tuna to aid the fishing fleet, and the domestic catch could not be increased to meet the need, cannery operations would be curtailed and shore employment decreased. Imports of frozen cooked tuna loins add to a canner's supply of raw material but eliminate a relatively large number of shoreworkers in the butchering and cleaning operations. Imports of frozen cooked tuna in cans also add to the canner's supply of raw material and eliminate additional shoreworkers in the can filling operation. Imports of tuna canned in oil or in brine eliminate all need for shoreworkers in domestic plants.

If further restrictions were placed on the imports of frozen cooked tuna loins, frozen cooked tuna in cans, and tuna canned in brine or oil, to aid shoreworkers, then domestic packers would have increased costs, and a lesser share of the market to the extent that domestic catches could not fill the gap. If additional restrictions were placed on imports of tuna canned in oil or in brine, then the fleet, the canners, and the shoreworkers would benefit while importers and distributors of canned tuna would suffer.

Lack of full employment for shoreworkers creates a difficult problem for many of them who do not possess skills permitting them to transfer readily to other industries. For others there is no alternative employment in their areas. Imports are both an advantage and a disadvantage to the shoreworker, depending upon the form in which the packer receives them. If the trend is toward the partially processed forms, then shoreworkers must find other employment, possibly at the cost of moving from the area in which they now are employed.

4. How can domestic canners be assured of supplying a fair share of the domestic market for canned tuna?

The needs of the domestic market are now supplied by tuna canned by domestic canners from the domestic catch and from imports of frozen round tuna, frozen cooked loins, and frozen cooked tuna in cans, and by importers of tuna and tunalike fishes canned in oil and in brine. If further restrictions were imposed on the imports of frozen round tuna or frozen cooked loins to aid the fishing fleet or the shoreworkers, then canning operations would suffer to the extent that the domestic catch could not fill the canners' raw material needs at a comparable price.

If further restrictions were placed on the importation of tuna or tunalike fishes canned in oil or in brine, all segments of the tuna industry, except importers and distributors of these products, should benefit from a greater market.

If further restrictions were placed on the imports of frozen cooked tuna in cans -- and use of the product is found to be feasible -- then canners, in the short view, might consider themselves deprived of an added and possibly more desirable raw material. In the long view, however, it seems almost certain that the importation and the successful and profitable canning of this product is one of the greatest threats to the domestic canning industry as it is now constituted. (Importation of frozen cooked loins presents the same threat, but to a lesser degree, since packing equipment not normal to other food canning plants is required.) There appears to be no reason why any fruit or vegetable canner, or, for that matter, almost any food canner, could not complete the processing of frozen cooked tuna in cans as readily as tuna canners.

They might do it more advantageously if the canned tuna shared overhead and marketing costs with the packers' major products. Custom canning also might occur and make it possible for large buyers to circumvent the usual marketing channels.

In summary, further restrictions on imports of frozen round tuna or frozen cooked loins would increase canners' costs and limit their ability to supply their markets. Lowering tariffs on imported tuna or tunalike fishes canned in oil or brine would create greater market competition which might be offset by increased demand. A trend toward, and the successful utilization of, imported frozen cooked tuna in cans might aid canners at first, but probably would eventually make canned tuna a byproduct of other canned food plants. Thus, the tuna canning industry faces problems which, at worst, could force the canning operation to foreign countries or transfer it to other food canning industries in this country.

5. How can the domestic consumer be assured of an adequate supply of canned tuna at a fair price?

Consumers have evidenced a keen and increasing desire for canned tuna. It seems obvious that their demands will be met from domestic or imported production or a combination of both. A fair price is another matter. If the domestic fleet can no longer compete with foreign production and is reduced in size or transferred to foreign registry, and if domestic canners become largely dependent on imports for their raw material, it will not take long for the exporting countries to eliminate the domestic canners by carrying out the canning function at home. When that occurs, they also can govern the price of canned tuna within certain limits.

Consumers, therefore, may have a considerable stake in whether we maintain a domestic tuna industry or become dependent on foreign canned tuna.

6. How can the domestic tuna industry meet the future demand for canned tuna?

The per capita consumption of canned tuna is increasing, which means that the industry, for a time, at least, must not only supply the added volume required by population growth but also a greater consumption per person. If the tuna industry solves all its other problems, the matter of increasing its supplies remains.

If the fishing fleets cannot catch the additional raw material required, then the tuna industry foregoes an opportunity for greater production and may even lose ground to some other more available fish or competing food.

7. How can the international problems involved in fishing for tuna be resolved in an equitable manner?

The international character of the tuna resource creates problems which are unique to fishing as a food producing operation and, to varying degrees, makes the domestic tuna fishing fleet subject to foreign regulations.

These regulations could become onerous and have a tendency to shift both fishing and processing operations from domestic to foreign bases.

If the fleet, through its own resources, or with State or Federal assistance, were successful in locating new resources, in adapting new fishing methods, or in devising a live bait substitute, this problem would diminish in importance.

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Manifold considerations concerned with surveying the long-range position of the domestic tuna industry in the domestic economy have been detailed in the previous chapters. It has been noted that the outlook for consumption of products of the tuna industry is a bright one. On the other hand, the prospects of major relative cost reductions in fishing and processing are rather bleak. Distribution, which is responsible for only a small part of the ultimate cost of canned tuna, does not offer any great prospect of cost savings as an aid in improving the position of the industry. In the light of these and associated determinations, suggestions are made herewith as to what may be done by the domestic tuna industry -- fishermen, processors, distributors, and importers -- and the Federal Government, to promote necessary adjustments so that the industry may achieve and maintain a sound position in the domestic economy.

Before considering what the Federal Government could or should do for the tuna industry, it is necessary to outline what the tuna industry has done for itself during the economic trials experienced in the past two years, and what it can do in the future. A review of its recent activity indicates that it has not been inactive in helping itself to surmount some of its problems.

Among the small craft fishermen there has been a considerable increase in the number of fishery cooperative marketing associations organized in the Pacific Coast States during the last two years. Most of these associations are groups of small boat operators who have organized in this manner to improve their lot. In March 1953, there were more than 15 fishery cooperative marketing associations controlled by small craft commercial fishermen actively participating in the marketing of tuna or purchasing supplies for operators of craft in the tuna fishery.

The large craft operators have also been active. The American Tunaboat Association, Inc., has organized as a fishery cooperative marketing association. The Fishermen's Cooperative Association of San Pedro, Inc., which has been operating for many years, has become more and more active with the business affairs of its members.

Fishermen, processors, distributors, and importers have not been laggard in carrying out their functions expeditiously and in line with the statements contained in Committee on Merchant Marine and Fisheries Document No. 18, 81st Congress. In this Document the Secretaries of State and Commerce stated that:

> "Every improvement that can be made in fishing vessels, processing equipment, transportation and distribution facilities, and in techniques used should help to reduce costs and increase returns to the industry."

The tuna industry has taken action along the following lines:

1. Large expenditures have been made for direct advertising by the domestic tuna industry, as indicated in table 15. In addition, direct advertising has been conducted by importers. The latter, while not as great in dollar amount, has been intense in certain selected areas of the Nation.

2. Packers have mechanized the canning of tuna to a large degree and are continuing efforts toward mechanization of the butchering and cleaning process. The packers also have cooperated with the Food and Drug Administration in developing Federal standards for tuna.

3. Distribution costs, including transportation and selling charges, have been held to a minimum. Retailers are handling tuna at relatively reasonable margins and, in many cases, are taking lesser margins than on other comparable foods.

4. Fishermen have been improving their vessels and gear, so far as they are financially able. New communication, navigational, and fishing aids are in evidence on the tuna fleet.

The fishery cooperative marketing associations previously mentioned have effected some monetary savings for their members. This has been done, for example, by purchasing group insurance at lower rates, purchasing group wharfage at lower charges per boat, and purchasing supplies on a quantitative basis and reselling them at savings to their members. In addition, some of these associations have handled the catch of their members and arranged for its sale, returning profits from such activity to the members. Those associations which have not done this have at least bargained collectively with canners and wholesalers to obtain the best possible price for the sale of members' catches.

The latter has been particularly true with respect to the American Tunaboat Association, Inc., and the Fishermen's Cooperative Association of San Pedro, Inc., the two large fishermen's groups in the tuna industry. These associations have been working toward improving conditions of sale for the members' products. Some recent accomplishments include establishment of prices for a better defined and longer period, guarantee of a market for three capacity trips for bait boats, limitations of the right of the canners for imposing limits on loads of fish, and arrangements for canners to allow fishermen to operate to a greater extent in the more productive seasons.

While the tuna industry has been very active, as organizations or individuals will be when faced by economic trials, there are some suggestions which can be made to the industry for further consideration in improving its lot.

It is recommended that the canners expand and improve their advertising efforts. This applies as well to importers. Market development can also be undertaken in conjunction with or supplemental to advertising. Among the aims should be expansion of consumption among low income groups and in the rural market, and the greater usage of tuna, for example, in hot dishes, etc. Canners could investigate thoroughly the possibility of expanding the consumption of tuna by marketing new products such as tuna combined with other ingredients in ready-to-serve form. Canners might also continue their work on technological improvements in processing. While the products of the tuna canneries are of a high quality, no effort should be spared in producing products of even better quality at competitive prices.

Canners should also consider the advisability of collecting, tabulating, and making available more fully and more widely monthly data on stocks of canned tuna at processors' and distributors' levels.

Fishermen should test newly located tuna grounds to determine if operating costs can be lowered. Experiments with long-line methods of taking offshore sub-surface stocks of tuna to determine the profitability of this method should be undertaken to prepare the industry for its use in the future, if necessary.

Since the actions and efforts of the tuna industry alone have not solved, and do not give promise of solving, its problems it is necessary to consider what aid the Federal Government might offer the industry. It is suggested, therefore, that the Federal Government consider the following actions:

1. Consideration should be given to the formulation of an international commodity agreement to cover trade in tuna. Such an agreement would be similar to, although not exactly the same as, the International Wheat Agreement of 1949, to which the United States is a party. At the outset the United States might invite those countries which are important producers, processors, and consumers of tuna to join with it in preparing such a document for trade in tuna. The objectives of such an international commodity agreement would be to stabilize production, processing, and trade, increase consumption, and make the wisest possible use of international tuna resources. In addition, such an agreement would supersede any unilateral action undertaken by governments now or in the future.

Such action would not be contrary to our commitments under the General Agreement on Tariffs and Trade. Any document consummated would necessarily have to be approved by the United States Senate and legislation related to effectively carrying out the agreement would have to be acted upon by both Houses of Congress. Exploratory steps in this matter are being taken by the Department of the Interior.

2. The several different forms of tariff rates on the various products of the tuna industry should be properly related. There is no logical relationship between a 45 percent ad valorem duty on tuna canned in oil, a 12½ percent duty on tuna canned in brine, and no duty on frozen tuna. The actual level of rates for these products is not suggested herein, only the suggestion that whatever the actual levels of rates may be, that the duties on the various products be properly related. The appropriate Executive and Independent agencies can furnish technical information in this regard which would help to accomplish this.

3. The Federal Government should continue and strengthen tuna research programs along the following lines:

a. Scientific studies of the tuna and bait populations to provide the basic knowledge of the resources which is now lacking, including adequate support of the Inter-American Tropical Tuna Commission.

b. Exploratory fishing to point the way for industry development of new tuna grounds.

c. Gear research and experimental fishing, in cooperation with the industry, to devise better and more efficient methods of locating and catching tuna.

d. A full scale research program aimed at finding an alternate tuna bait which would relieve the fleet of its dependence on foreign bait grounds.

e. A marketing and economic research program, comparable to that provided competing foods, to aid the industry in expanding consumption and finding solutions to its economic problems.

4. Enact into law the provisions of S.1731, 83rd Congress, which provides that $1,000,000 of "Section 32" funds be transferred to the Department of the Interior by the Department of Agriculture, to be used for technological and related research, an educational service, and market development work for the fishing industry. These funds are derived from 30 percent of the duties on all imported products, and are available to the Department of Agriculture for assisting in the marketing of agricultural products. Devoting an equitable portion of these import duties to help solve the problems caused by the imports of tuna is a logical use for the funds. Legislation of this type has the support of important segments of the domestic fishing industry.

5. In view of the existence, on a large scale, of fishery cooperative marketing associations in the tuna industry, enact into law the provisions of S. 1902, 81st Congress, which would permit these associations to have access to the Bank for Cooperatives in the Farm Credit Administration. Fishery cooperatives do not now have such access. It would aid them to have some of their financing done through this experienced agency in the same manner as do agricultural cooperatives. This legislation would not set up a duplicating agency. It would simply allow the fishery cooperatives to participate in the present services of the Bank for Cooperatives under regulations to be prescribed by the Secretary of the Interior.

6. Efforts should be continued toward obtaining a satisfactory solution to the problem of territorial seas and fisheries jurisdictions therein and to clarify the rights of United States fishermen.

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